Web Programming
JavaScript Part II.

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Outline

- So far
  - JavaScript syntax, control statements, variables, functions, objects
  - Built-in objects (Math, Array, etc.)
- Today
  - Event-driven programming
  - Manipulating the DOM

Events and event handling

- *Event-driven programming*: execution is triggered by user actions
- *Event* is a notification that something specific has occurred
- *Event handler* is a script that is executed in response to the appearance of an event
- HTML tags are used to connect events to handlers

```
<div class="green" ondblclick="myEvent('green double clicked');"></div>
```

event (double click)

event handler

Events

- Mouse events
- Keyboard events
- Frame/object events
- Form events
- … and more
  - Clipboard, print, media, animation, etc.
- See http://www.w3schools.com/jsref/dom_obj_event.asp for the full list

Mouse events

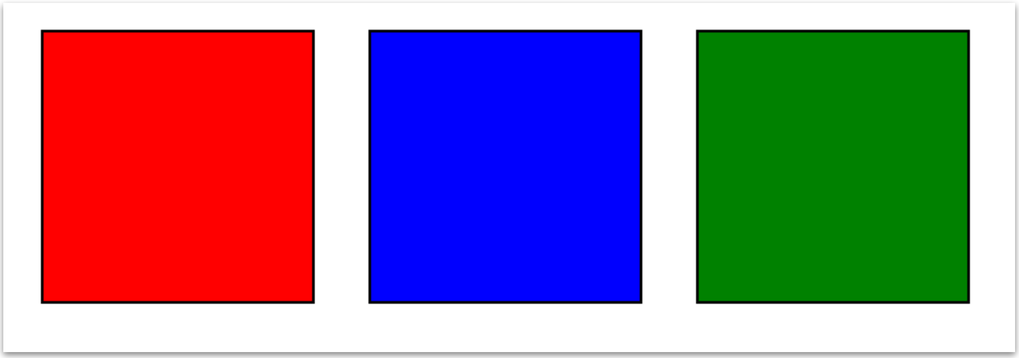
- **`onclick`** — click on an element
- **`ondblclick`** — double click on an element
- **`onmousedown`** — mouse button pressed over an element
- **`onmouseup`** — mouse button released over an element
- **`onmouseover`** — when the pointer is moved onto an element, or onto one of its children
- **`onmouseout`** — when a user moves the mouse pointer out of an element, or out of one of its children

Example

examples/js/events_dom/mouse_events.html

```
<script>
    function myEvent(message) {
        alert(message);
    }
</script>
```

```
<div class="red" onmouseover="alert('red alert');"></div>
<div class="blue" onclick="alert('blue clicked');" ></div>
<div class="green" ondblclick="myEvent('green double clicked');"></div>
```



Mouse event properties

- Further properties of the event can be accessed
  - **`button`** — which mouse button was pressed
  - **`clientX, clientY`** — coordinates of the mouse pointer, relative to the current window
  - **`screenX, screenY`** — coordinates of the mouse pointer, relative to the screen
  - **`shiftKey, ctrlKey, altKey, metaKey`** — boolean properties, reflecting the state of corresponding key: Shift, Ctrl, Alt or Command (Mac only)

Example

examples/js/events_dom/mouse_event_logger.html

```
<script>
    function mhandle(event) {
        var msg = event.type
                + " button=" + event.button
                + " clientCoord=(" + event.clientX + ", " + event.clientY + ")"
                + " screenCoord=(" + event.screenX + ", " + event.screenY + ")"
                + (event.shiftKey ? " +shift" : "")
                + (event.ctrlKey ? " +ctrl" : "")
                + (event.altKey ? " +alt" : "")
                + (event.metaKey ? " +meta" : "");
        document.getElementById("log").innerHTML += msg + "\n";
    }
</script>
```

```
<div onclick="mhandle(event);"></div>
```

Keyboard events

- **`onkeydown`** — when the user is pressing a key
- **`onkeypress`** — when the user presses a key (triggers after keydown)
- **`onkeyup`** — when the user releases a key

Working with keyboard events

- Keydown/keyup are for any keys
- Keypress is for characters
- Key event properties
  - **`keyCode`** — the scan-code of the key (i.e., which key was pressed; it's the same for "a" and "A")
  - **`charCode`** — the ASCII character code
  - **`shiftKey, ctrlKey, altKey, metaKey`** — boolean properties, reflecting the state of corresponding key: Shift, Ctrl, Alt or Command (Mac only)

Example

examples/js/events_dom/keyboard_event_logger.html

```
<script>
    function khandle(event) {
        var msg = event.type
                + " keyCode=" + event.keyCode
                + " charCode=" + event.charCode
                + (event.shiftKey ? " +shift" : "")
                + (event.ctrlKey ? " +ctrl" : "")
                + (event.altKey ? " +alt" : "")
                + (event.metaKey ? " +meta" : "");
        document.getElementById("log").innerHTML += msg + "\n";
    }
</script>
```

```
<input type="text" id="kinput" onkeydown="khandle(event);"
onkeyup="khandle(event);" onkeypress="khandle(event);"/><br/>
Log:<br/>
<textarea rows="18" id="log"></textarea>
```

Frame/object events

- **`onload`** — when an object has loaded
  - Most common usage: **`<body onload="…">`**
- **`onpageshow`** — when the user navigates to a webpage
- **`onpagehide`** — when the user navigates away from a webpage
- **`onresize`** — when the document view is resized
- **`onscroll`** — when an element's scrollbar is being scrolled

Example

examples/js/events_dom/frame_events.html

```
<body onload="alert('page loaded');"
      onpageshow="console.log('navigated to page');"
      onpagehide="console.log('navigated away from page');">
```

Form events

- **`onfocus`** — when an element gets focus
- **`onblur`** — when an element loses focus
- **`onchange`** — when the content/state of a form element has changed (for `<input>`, <select>, and <textarea>)
- **`oninput`** — when an element gets user input (for <input> and <textarea>)
- **`onsubmit`** — when a form is submitted
- **`onreset`** — when a form is reset

onchange vs. oninput

- **`oninput`** occurs immediately after the value of an element has changed
- **`onchange`** occurs when the element loses focus, after the content has been changed
- **`onchange`** also works for <select> (not just <input> and <textarea>)

Example

examples/js/events_dom/form_events.html

```
<script>
    function setfocus(element) {
        element.style.backgroundColor = "yellow";
    }
   function input(element) {
        console.log(element.name + " oninput: " + element.value);
    }
</script>
```

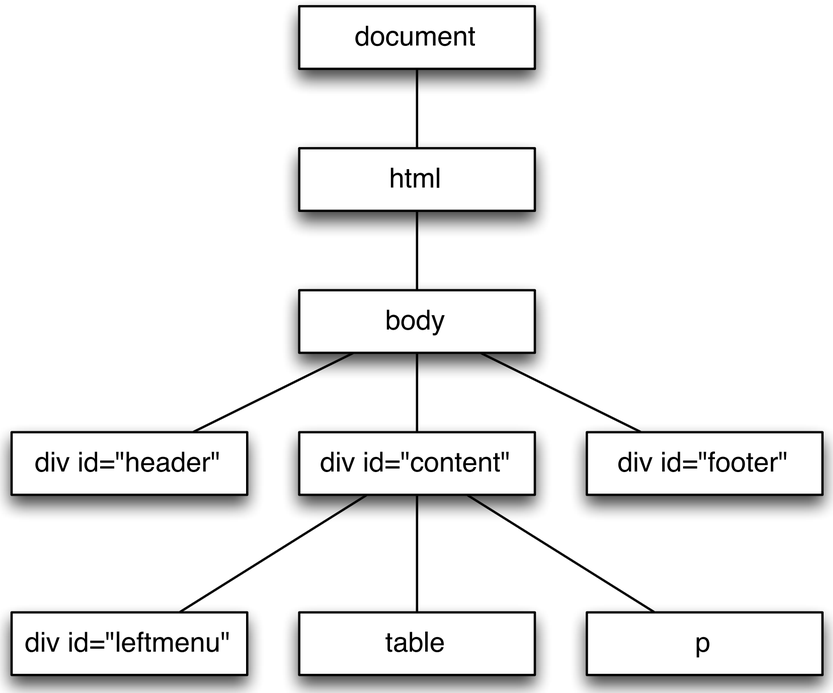
```
<form name="test" onsubmit="alert('form submitted');">

<input type="text" name="name" size="20" placeholder="Firstname, lastname"
       onfocus="setfocus(this);"
       onblur="losefocus(this);"
       oninput="input(this);"
       onchange="change(this);"/>
```

this refers to the this particular <input> element

Document Object Model (DOM)

- Internal model of the HTML page
- Consistent way (across all browsers) to gain access to the structure and content of HTML
- A tree of HTML elements
- **Object** model
  - Each HTML elements is an object (with methods and properties)
  - Plus two additional objects: document and window



Interacting with the DOM

- JavaScript can interact with the DOM to get access to the elements and the content in them
  - Getting and setting the attributes of elements
  - Creating or adding elements
  - Removing elements

Wait until the page has fully loaded!

- In most cases, we need to wait for the DOM to be fully created before start executing JavaScript code

```
<script>
    function init() {
        ...
    }

    window.onload = init;
</script>
```

The **init()** function is assigned to the onload event of the (browser) window.

Finding HTML elements

- Finding elements by ID
  - Typically saved to a variable so that we can refer to the element throughout the code

```
var element = document.getElementById("someid");
```

- Finding elements by tag/class name
  - E.g., listing names and values of all input elements

```
var x = document.getElementsByTagName("input");
for (var i = 0; i < x.length; i++) {
    console.log(x[i].name + ": " + x[i].value);
}
```

Getting properties of HTML elements

- **`id`** — the value of the id attribute
- **`innerHTML`** — the HTML content (between the opening and closing tags)

```
var mydiv = document.getElementById("mydiv");
console.log("HTML content: " + mydiv.innerHTML);
```

- **`tagName`** — the name of the HTML tag (in uppercase, e.g., P, DIV, H1, etc.)
- **`getAttribute()`** — a specific attribute's value
- See a full list of properties and methods of the element object http://www.w3schools.com/jsref/dom_obj_all.asp

Changing HTML elements

- Change the inner HTML

```
document.getElementById("mydiv").innerHTML = "new content";
```

```
document.getElementById("mydiv").innerHTML = "<p>new content</p>";
```

- Change the value of a specific attribute

```
document.getElementById("myImage").src = "landscape.jpg";
```

```
document.getElementById("myImage").setAttribute("src", "landscape.jpg");
```

Changing CSS properties

- **`style.x`** — the value of a style property **`x`**
  - See http://www.w3schools.com/jsref/dom_obj_style.asp
- Change the style property of an HTML element

```
document.getElementById("mydiv").style.height = "200px";
```

```
document.getElementById("mydiv").style.backgroundColor = "blue";
```

- Add/remove classes assigned to a HTML element

```
var div = document.getElementById("mydiv");

if (!div.classList.contains("border")) {
    div.classList.add("border");
}
else {
    div.classList.remove("border");
}
```

Assigning events to elements (1)

- Setting the element's **on…** attribute in HTML

```
<script>
    function dosomething() {
        …
    }
</script>
```

```
<div id="mydiv" onclick="dosomething()"></div>
```

Assigning events to elements (2)

- Modifying the element's **on…** property

```
<script>
    function dosomething() {
        …
    }
    function init() {
        document.getElementById("mydiv").onclick = dosomething;
    }
    window.onload = init;
</script>
```

```
<div id="mydiv"></div>
```

Assigning events to elements (3)

- Using event listeners
  - Attaches an event handler to an element without overwriting existing event handlers
  - Multiple event handlers might be added to one element

```
document.getElementById("myBtn").addEventListener("click", showAlert);
document.getElementById("myBtn").addEventListener("click", log);
```

  - Event listeners can be removed too

```
document.getElementById("myBtn").removeEventListener("click", showAlert);
```

  - See http://www.w3schools.com/js/js_htmldom_eventlistener.asp

Passing parameters to event handlers

- Functions assigned to events from JS cannot take arguments
  - Otherwise the function is immediately executed

```
function changeColor(element) {
    …
}
function init() {
    var mydiv = document.getElementById("mydiv");
    mydiv.style.backgroundColor = "blue";
    mydiv.onclick = changeColor(mydiv);
}
```

Wrong! changeColor() executes immediately

- Solution: use an "anonymous function" that calls the specified function with the parameters

```
mydiv.onclick = function() {changeColor(mydiv);}
```

Example

examples/js/events_dom/event_listeners.html

```
function init() {
    // assign showAlert() and log() to all divs
    var x = document.getElementsByTagName("div");
    for (var i = 0; i < x.length; i++) {
        x[i].addEventListener("click", showAlert);
        x[i].addEventListener("click", log);
    }

    // remove log() from elements that have the nolog class
    x = document.getElementsByClassName("nolog");
    for (var i = 0; i < x.length; i++) {
        x[i].removeEventListener("click", log);
    }
}
```

Exercises #1, #2 (#2b)

https://github.com/kbalog/web-programming/tree/master/**exercises/js/events_dom**

Working with forms

- Different element properties, depending on the type of input
- Common
  - **`name`** — name attribute
  - **`type`** — which type of form element it is
  - **`disabled`** — whether the element is disabled or not
  - **`form`** — reference to the form that contains the element
  - **`required`** — whether the input must be filled out before submitting the form

Input text object

- <input> and <textarea> elements
  - **`value`** — get or set the value of the element
- See
  - http://www.w3schools.com/jsref/dom_obj_text.asp
  - http://www.w3schools.com/jsref/dom_obj_textarea.asp

```
<script>
    var name = document.getElementById("name");
    console.log("Name: " + name.value);
</script>
```

```
<input type="text" name="name" id="name"/>
```

Select list

- Properties
  - **`length`** — number of options in the list
  - **`selectedIndex`** — index of the selected option
  - **`options[index].value`** — value of the selected option
  - **`options[index].text`** — text corresponding to the selected option
- See
  - http://www.w3schools.com/jsref/dom_obj_select.asp

Select list example

examples/js/events_dom/form_events.html

```
<script>
    function processForm() {
        var name = document.getElementById("name");
        console.log("Name: " + name.value);

        var country = document.getElementById("country");
        for (var i = 0; i < country.length; i++) {
            console.log("[" + country[i].value + "] " + country[i].text
                        + (country[i].selected ? " selected" : ""));
        }
        console.log("Selected: " + country.options[country.selectedIndex].text);
    }
</script>
```

```
<select name="country" id="country" onchange="processForm();">
    <option value="--">Select</option>
    <option value="NO">Norway</option>
    <option value="SE">Sweden</option>
    <option value="DK">Denmark</option>
</select>
```

Input checkbox and radio

- Properties
  - **`checked`** — sets or returns the checked state
- See
  - http://www.w3schools.com/jsref/dom_obj_checkbox.asp
  - http://www.w3schools.com/jsref/dom_obj_radio.asp

Checkbox example

examples/js/events_dom/form_events.html

```
<script>
    function processForm() {

        var delivery = document.getElementsByName("delivery");
        for (var i = 0; i < delivery.length; i++) {
            console.log("[" + (delivery[i].checked ? "X" : " ") + "] "
                        + delivery[i].value);
        }
    }
</script>
```

```
<label>Delivery
    <input type="radio" name="delivery" value="normal">Normal
    <input type="radio" name="delivery" value="extra">Extra
    <input type="radio" name="delivery" value="hyper">Hyper
</label>
```

Form validation using JavaScript

```
<script>
    function checkForm() {
        var valid = true;

        // perform input check
        // set valid to false if it fails

        return valid;
    }
</script>
```

```
<form name="test" action="…" onsubmit="return checkForm();">
…
</form>
```

If the **checkForm()** function returns **true** the form will submit. If **false**, the form does nothing.

Exercises #3, #4

https://github.com/kbalog/web-programming/tree/master/
exercises/js/events_dom

DOM nodes

- Everything is a node
  - The document itself is a document node
  - All HTML elements are element nodes
  - All HTML attributes are attribute nodes
  - Text inside HTML elements are text nodes
  - Comments are comment nodes
- The **`nodeType`** property returns the type of the node

Traversing the DOM

- Finding child elements (excl. text and comment nodes)
  - **`childElementCount`** — number of child element an element has
  - **`children`** — child nodes of an element
  - **`hasChildNodes()`** — if an element has any child nodes
- Finding child elements (incl. text and comment nodes)
  - **`childNode`** — child nodes of an element
    - The number of elements can be accessed using **`childNode.length`**
- Finding parent element
  - **`parentNode`** — reference to the parent of the element

Example

examples/js/events_dom/dom_traverse.html

```
function traverse(element, level) {
    var line = "";
    // indentation
    for (var i = 0; i < level; i++) {
        line += "  ";
    }
    // print element
    line += element.nodeName;
    console.log(line);

    // recursively traverse child elements
    if (element.hasChildNodes()) {
        for (var i = 0; i < element.children.length; i++) {
            traverse(element.children[i], level + 1);
        }
    }
}

window.onload = function () {
    traverse(document.body, 0);
}
```

Traversing the DOM (2)

- Some convenience properties
  - **`firstChild`** — first child node of an element
  - **`firstElementChild`** — first child element of an element
  - **`lastChild`** — last child node of an element
  - **`lastElementChild`** — last child element of an element
  - **`nextSibling`** — next node at the same node tree level
  - **`nextElementSibling`** — next element at the same node tree level
  - **`previousSibling`** — previous node at the same node tree level
  - **`previousElementSibling`** — previous element at the same node tree level
  - **`parentElement`** — parent element node of an element

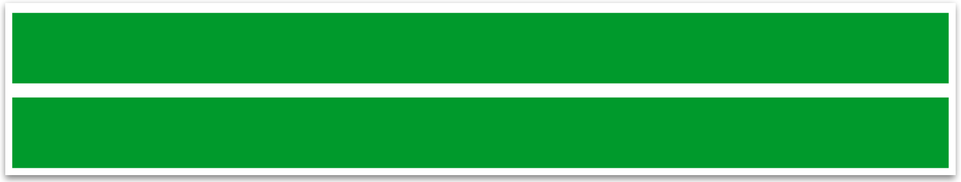
Exercises #5, #6, (#6b)

https://github.com/kbalog/web-programming/tree/master/**exercises/js/events_dom**

Hint for Exercise #6

- Change the **`style.display`** or **`style.visibility`** property
- Remember the difference

CSS
```
#mydiv {
    style.display: none;
}
```



CSS
```
#mydiv {
    visibility: hidden;
}
```

Creating HTML elements

- To add a new HTML element
  - Create the element

```
var h2 = document.createElement("h2");
```

  - Set the content of the element

```
h2.innerHTML = "Article header";
```

    - or

```
var text = document.createTextNode("Article header");
h2.appendChild(text);
```

  - Append it to an existing element (otherwise it won't appear on the page)

```
var art1 = document.getElementById("article1");
art1.appendChild(h2);
```

Inserting new HTML element

- **`appendChild()`** adds new element after the last child element of the parent
- **`insertBefore()`** inserts before a specified child node

```
var newItem = document.createElement("li");
newItem.innerHTML = "Water";
// get the parent element
var list = document.getElementById("mylist");
// insert before the first child
list.insertBefore(newItem, list.children[0]);
```

Removing or replacing HTML elements

- To remove or replace a HTML element
  - You must know the parent of the element
    - If you identified the element, you can use the **`parentNode`** property to find its parent
- **`removeChild()`** — removes a given child element

```
var art1 = document.getElementById("article1");
art1.parentNode.removeChild(art1);
```

- **`replaceChild()`** — replaces a given child element

```
var art1 = document.getElementById("article1");
var art2 = document.createElement("article");
art1.parentNode.replaceChild(art2, art1);
```

Example

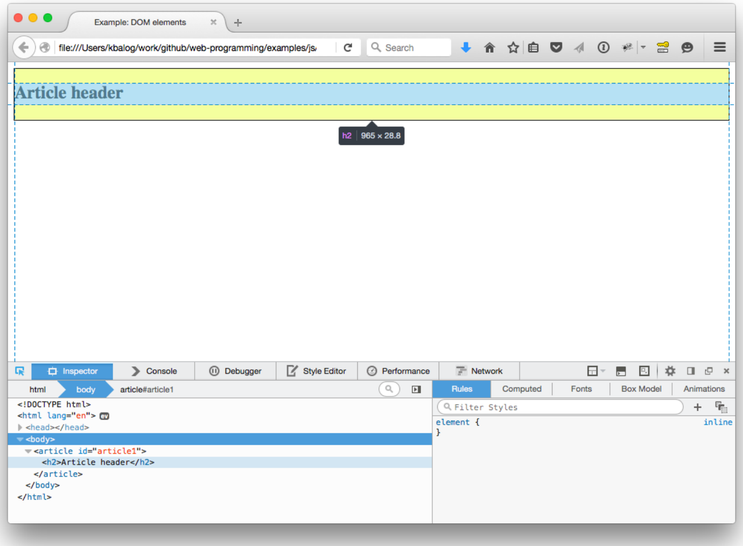
examples/js/events_dom/dom_elements.html

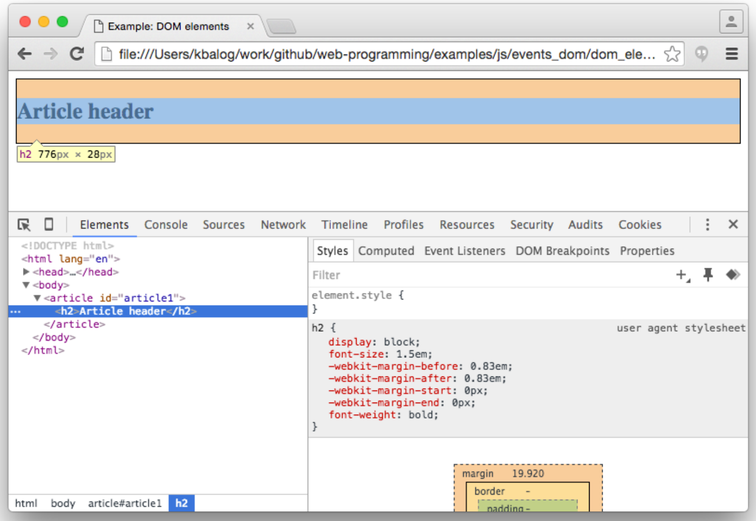
```
<script>
    function addArticleHeader() {
        // create a new heading
        var h2 = document.createElement("h2");
        // set the content of the new element
        h2.innerHTML = "Article header";
        // identify parent element
        var art1 = document.getElementById("article1");
        // append to parent element
        art1.appendChild(h2);
    }
</script>
```

```
<body>
    <article id="article1"></article>
</body>
```

Dev hint

- When using JS to change the DOM, use the browser's web inspector tool to see the modified HTML source
  - Viewing the page source will only show the initial HTML





Exercise #7, (#7b)

https://github.com/kbalog/web-programming/tree/master/
exercises/js/events_dom

Browser Object Model (BOM)

- Window object — represents a browser window
  - Various popup windows (alert, confirm, prompt)
  - Opening new window and closing current window
  - Moving and scrolling the document
  - See http://www.w3schools.com/jsref/obj_window.asp
- Location object (part of the Window object)
  - Contains information about the current URL
  - See http://www.w3schools.com/jsref/obj_location.asp

Browser Object Model (BOM)

- History object (part of the Window object)
  - Contains information about the URLs visited by the user
  - See http://www.w3schools.com/jsref/obj_history.asp
- Screen
  - Dimensions, resolution, color depth of the screen
  - See http://www.w3schools.com/jsref/obj_screen.asp
- Navigator
  - Information about the browser (name, platform, version, etc.)
  - See http://www.w3schools.com/jsref/obj_navigator.asp

Exercises #8, #9

https://github.com/kbalog/web-programming/tree/master/
exercises/js/events_dom

References

- W3C JavaScript and HTML DOM reference
  http://www.w3schools.com/jsref/default.asp
- W3C JS School
  http://www.w3schools.com/js/default.asp
- Mozilla JavaScript reference
  https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference