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Knockout

# Using JavaScript for Client-Side Behavior

Internet Applications, ID1354

# Contents

- The Document Object Model, DOM
- The Browser Object Model, BOM
- The jQuery JavaScript Library
- AJAX
- Long Polling
- WebSocket
- The Knockout JavaScript Framework

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# Section

- The Document Object Model, DOM
- The Browser Object Model, BOM
- The jQuery JavaScript Library
- AJAX
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- The Knockout JavaScript Framework

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# The Document Object Model, DOM

- ▶ The W3C Document Object Model, DOM, is an API that allows programs to **access and update document content**.

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# The Document Object Model, DOM

- ▶ The W3C Document Object Model, DOM, is an API that allows programs to **access and update document content**.
- ▶ Defines **objects** representing HTML elements, **methods** to access HTML elements, and **events** generated by HTML elements.

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# The Document Object Model, DOM

- ▶ The W3C Document Object Model, DOM, is an API that allows programs to **access and update document content**.
- ▶ Defines **objects** representing HTML elements, **methods** to access HTML elements, and **events** generated by HTML elements.
- ▶ The best that can be said about **browser support** is that it varies.

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# The Document Object Model, DOM

- ▶ The W3C Document Object Model, DOM, is an API that allows programs to **access and update document content**.
- ▶ Defines **objects** representing HTML elements, **methods** to access HTML elements, and **events** generated by HTML elements.
- ▶ The best that can be said about **browser support** is that it varies.
  - ▶ Try the features you want to use in all relevant browsers, check **caniuse.com**, etc

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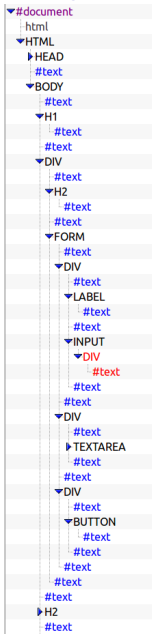
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# The DOM Tree



- ▶ The DOM objects are organized in a **tree**.
- ▶ The picture to the left is a part of the DOM tree for the course's **chat program**.

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# The DOM JavaScript API

- ▶ All HTML elements are represented by **objects**.

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# The DOM JavaScript API

- ▶ All HTML elements are represented by **objects**.
- ▶ The HTML objects have **properties** you can get or set, to read or update the objects.

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# The DOM JavaScript API

- ▶ All HTML elements are represented by **objects**.
- ▶ The HTML objects have **properties** you can get or set, to read or update the objects.
- ▶ The HTML objects have **methods**, for example for adding and deleting elements.

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# The DOM JavaScript API

- ▶ All HTML elements are represented by **objects**.
- ▶ The HTML objects have **properties** you can get or set, to read or update the objects.
- ▶ The HTML objects have **methods**, for example for adding and deleting elements.
- ▶ An example is the JavaScript statement

```
document.getElementById("demo").innerHTML =  
    "Hello World!";
```

that uses the method **getElementById** to find the HTML object for the element with id **demo**, and sets the HTML of that object to **"Hello World!"**, using the **innerHTML** property.

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# The **document** Object

- ▶ The object **document** can be accessed by any JavaScript code. It **represents the entire web page** and is the entry point to the DOM API.

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# The **document** Object

- ▶ The object **document** can be accessed by any JavaScript code. It **represents the entire web page** and is the entry point to the DOM API.
- ▶ Sample methods in **document** are  
Find HTML elements `getElementById`,  
`getElementsByTagName`,  
`getElementsByClassName`

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# The **document** Object

- ▶ The object **document** can be accessed by any JavaScript code. It **represents the entire web page** and is the entry point to the DOM API.
- ▶ **Sample methods in **document** are**

Find HTML elements `getElementById,`  
`getElementsByTagName,`  
`getElementsByClassName`

Properties of HTML elements `innerHTML, attribute`

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# The **document** Object

- ▶ The object **document** can be accessed by any JavaScript code. It **represents the entire web page** and is the entry point to the DOM API.
- ▶ Sample methods in **document** are

Find HTML elements `getElementById,`  
`getElementsByTagName,`  
`getElementsByClassName`

Properties of HTML elements `innerHTML, attribute`

Add or delete elements `createElement,`  
`removeChild, appendChild`

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# The **document** Object

- ▶ The object **document** can be accessed by any JavaScript code. It **represents the entire web page** and is the entry point to the DOM API.
- ▶ **Sample methods in document** are

Find HTML elements `getElementById,`  
`getElementsByTagName,`  
`getElementsByClassName`

Properties of HTML elements `innerHTML, attribute`

Add or delete elements `createElement,`  
`removeChild, appendChild`

Collections of HTML elements `cookie, URL, elements,`  
`forms`

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# Change CSS Rules

- ▶ To change CSS rules use the following type of statement:

```
document.getElementById(id).style.<property>  
    = <some style>
```

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# Change CSS Rules

- ▶ To change CSS rules use the following type of statement:

```
document.getElementById(id).style.<property>
    = <some style>
```

- ▶ For example, the statement

```
document.getElementById("p2").style.color =
    "blue";
```

changes the **font color of element with id p2** to blue.

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# Events

- ▶ The DOM defines many **events**, for example **onClick**, which is fired by an element when the user clicks on it.

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# Events

- ▶ The DOM defines many **events**, for example **onClick**, which is fired by an element when the user clicks on it.
- ▶ To react to an event, add JavaScript code to the **event handler attribute** of the element that generates the event.

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# Events

- ▶ The DOM defines many **events**, for example **onClick**, which is fired by an element when the user clicks on it.
- ▶ To react to an event, add JavaScript code to the **event handler attribute** of the element that generates the event.
- ▶ For example, to **change text** in the paragraph when the user clicks it:

```
<p onclick="clicked(this)">Click Me!</p>
```

```
function clicked(source) {  
    source.innerHTML = "You clicked";  
}
```

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# Examples of Events

Mouse events **onclick**, **ondblclick**,  
**onmousedown**, **onmouseover**

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# Examples of Events

Mouse events **onclick**, **ondblclick**,  
**onmousedown**, **onmouseover**

Keyboard events **onkeydown**, **onkeypress**,  
**onkeyup**, fired in that order.

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# Examples of Events

Mouse events **onclick**, **ondblclick**,  
**onmousedown**, **onmouseover**

Keyboard events **onkeydown**, **onkeypress**,  
**onkeyup**, fired in that order.

Object events **onload**, **onunload**

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# Examples of Events

Mouse events **onclick**, **ondblclick**,  
**onmousedown**, **onmouseover**

Keyboard events **onkeydown**, **onkeypress**,  
**onkeyup**, fired in that order.

Object events **onload**, **onunload**

Form events **onchange**, **onselect**

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# Event Listeners

- ▶ The JavaScript function **addEventListener()** attaches an event listener to the specified element.

```
<button id="myBtn">Try it</button>  
<p id="demo"></p>
```

```
document.getElementById("myBtn").  
    addEventListener("click", displayDate);  
  
function displayDate() {  
    document.getElementById("demo").  
        innerHTML = Date();  
}
```

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# Event Listeners

- ▶ The JavaScript function `addEventListener()` attaches an event listener to the specified element.

```
<button id="myBtn">Try it</button>  
<p id="demo"></p>
```

```
document.getElementById("myBtn").  
    addEventListener("click", displayDate);  
  
function displayDate() {  
    document.getElementById("demo").  
        innerHTML = Date();  
}
```

- ▶ **Multiple** event listeners, even of the same type, can be attached to the same element.

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# Event Listeners

- ▶ The JavaScript function `addEventListener()` attaches an event listener to the specified element.

```
<button id="myBtn">Try it</button>
<p id="demo"></p>
```

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

function displayDate() {
    document.getElementById("demo") .
        innerHTML = Date();
}
```

- ▶ **Multiple** event listeners, even of the same type, can be attached to the same element.
- ▶ **Event listeners** is preferred over `onEvent` attributes since it separates JavaScript from HTML, thereby increasing **cohesion**.

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# Passing Parameters to Event Listeners

- ▶ The following code illustrates how to pass **parameters** to event listeners.

```
<button id="myBtn">Try it</button>  
<p id="demo"></p>
```

```
document.getElementById("myBtn").  
  addEventListener("click", function() {  
    showLabel(this);  
  });  
  
function showLabel(source) {  
  document.getElementById("demo").innerHTML  
    = source.innerHTML;  
}
```

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# Question 1



# Event Bubbling

- ▶ When an element fires an event, also the event handlers of its **parents** are invoked.

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# Event Bubbling

- ▶ When an element fires an event, also the event handlers of its **parents** are invoked.
- ▶ An event first triggers the **deepest** possible element, **then its parents** in nesting order.

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# Event Bubbling Example

## ▶ HTML:

```
<div onclick="show(1)">1
  <div onclick="show(2)">2
    <div onclick="show(3)">3
      <p id="event-log"></p>
    </div>
  </div>
</div>
```

## JavaScript:

```
function show(sourceNo) {
  var curr = document.
    getElementById("event-log").innerHTML;
  document.getElementById("event-log").
    innerHTML = curr + " " + sourceNo;
}
```

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# Event Bubbling Example

## ▶ HTML:

```
<div onclick="show(1)">1
  <div onclick="show(2)">2
    <div onclick="show(3)">3
      <p id="event-log"></p>
    </div>
  </div>
</div>
```

## JavaScript:

```
function show(sourceNo) {
  var curr = document.
    getElementById("event-log").innerHTML;
  document.getElementById("event-log").
    innerHTML = curr + " " + sourceNo;
}
```

- ▶ When clicking the **innermost** div (number 3), the output is **3 2 1**

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# Stopping the Bubbling

- ▶ Bubbling is prevented by calling **stopPropagation()** on the **event** object.

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# Stopping the Bubbling

- ▶ Bubbling is prevented by calling `stopPropagation()` on the `event` object.

```
<div onclick="show(1)">1
  <div onclick="show(2)">2
    <div onclick='show(3, event) '>3
      <p id="log"></p>
    </div>
  </div>
</div>
```

```
function show(sourceNo, event) {
  var curr = document.
    getElementById("log").innerHTML;
  document.getElementById("log").
    innerHTML = curr + " " + sourceNo;
  event.stopPropagation();
}
```

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# Stopping the Bubbling

- ▶ Bubbling is prevented by calling `stopPropagation()` on the `event` object.

```
<div onclick="show(1)">1
  <div onclick="show(2)">2
    <div onclick='show(3, event) '>3
      <p id="log"></p>
    </div>
  </div>
</div>
```

```
function show(sourceNo, event) {
  var curr = document.
    getElementById("log").innerHTML;
  document.getElementById("log").
    innerHTML = curr + " " + sourceNo;
  event.stopPropagation();
}
```

- ▶ When clicking the `innermost` div, output is now 3

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# Event Capturing

- ▶ Before bubbling, the event goes the other way, from **outermost to innermost** element. This is called **capturing**.

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# Event Capturing

- ▶ Before bubbling, the event goes the other way, from **outermost to innermost** element. This is called **capturing**.
- ▶ The capturing phase is ignored by all **onEvent** attributes and event listeners, except listeners with the **useCapture** argument **set to true**:

```
document.getElementById("myId").  
    addEventListener("click", handler, true);
```

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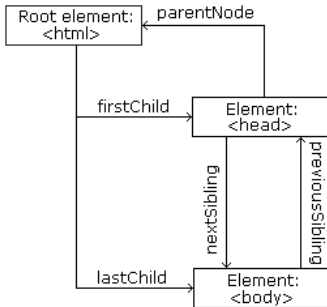
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# Navigating the DOM Tree



- ▶ The image to the left illustrates **parent**, **child** and **sibling** relationships between nodes in the DOM tree.

Image from  
[http://www.w3schools.com/js/js\\_htmlDOM\\_navigation.asp](http://www.w3schools.com/js/js_htmlDOM_navigation.asp)

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# Navigating the DOM Tree

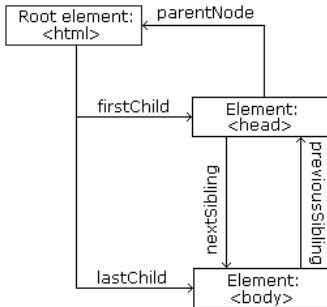


Image from  
[http://www.w3schools.com/js/js\\_htmlDOM\\_navigation.asp](http://www.w3schools.com/js/js_htmlDOM_navigation.asp)

- ▶ The image to the left illustrates **parent**, **child** and **sibling** relationships between nodes in the DOM tree.
- ▶ The DOM tree can be **navigated** with the node properties **parentNode**, **childNodes**, **firstChild**, **lastChild**, **nextSibling**, and **previousSibling**

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# Navigating the DOM Tree (Cont'd)

- ▶ Note that, in the code below, the **<p>** node contains a **child text node** with the value **the text**

```
<p>the text</p>
```

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# Navigating the DOM Tree (Cont'd)

- ▶ Note that, in the code below, the `<p>` node contains a **child text node** with the value **the text**

```
<p>the text</p>
```

- ▶ Text content can be accessed with the **innerHTML** and **nodeValue** properties.

```
<p id="demo">text content</p>
```

Using **innerHTML**:

```
var text = document.getElementById("demo").  
    innerHTML;
```

Using **nodeValue**:

```
var text = document.getElementById("demo").  
    childNodes[0].nodeValue;
```

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# Adding Elements

- ▶ To add a new element, first **create** it, then **insert** it in the DOM tree.

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

```
var elem = document.createElement("p");  
var text =  
    document.createTextNode("added element");  
elem.appendChild(text);  
document.getElementById("target").  
    appendChild(elem);
```

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# Removing Elements

- ▶ To remove an element, use the **removeChild** method.

```
<div id="parent">  
  <p>To be removed</p>  
</div>
```

```
var parent =  
    document.getElementById("parent");  
var child =  
    parent.getElementsByTagName("p")[0];  
parent.removeChild(child);
```

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# Question 2



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# The Browser Object Model, BOM

- ▶ While the DOM provides an API for accessing the current document, the **Browser Object Model, BOM**, provides an API that gives **access to the browser**.

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# The Browser Object Model, BOM

- ▶ While the DOM provides an API for accessing the current document, the **Browser Object Model, BOM**, provides an API that gives **access to the browser**.
- ▶ The BOM is **not standardized**, but more or less the same methods are implemented in all modern browsers.

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# The Browser Object Model, BOM

- ▶ While the DOM provides an API for accessing the current document, the **Browser Object Model, BOM**, provides an API that gives **access to the browser**.
- ▶ The BOM is **not standardized**, but more or less the same methods are implemented in all modern browsers.
- ▶ The following slides contain a **short overview of major objects** and methods, to give an idea of what can be done with the BOM.

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# BOM Objects

- ▶ The **window** object has:
  - ▶ Properties for **height and width** of the browser window.
  - ▶ Methods to **open, close, move and resize** the browser window.
  - ▶ Methods to execute some code at specified **time-intervals**.

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# BOM Objects

- ▶ The **window** object has:
  - ▶ Properties for **height and width** of the browser window.
  - ▶ Methods to **open, close, move and resize** the browser window.
  - ▶ Methods to execute some code at specified **time-intervals**.
- ▶ The **location** object has:
  - ▶ Properties that gives information about the **current URL**.
  - ▶ The **assign** method that **loads a new document**.

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# BOM Objects (Cont'd)

- ▶ The **navigator** object can give information about **browser type and browser features**.

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# BOM Objects (Cont'd)

- ▶ The **navigator** object can give information about **browser type and browser features**.
- ▶ The **screen** object has properties for **height, width and pixel depth** of the user's screen.

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# BOM Objects (Cont'd)

- ▶ The **navigator** object can give information about **browser type and browser features**.
- ▶ The **screen** object has properties for **height, width and pixel depth** of the user's screen.
- ▶ The **document** object has the **cookie** property, which is used to get and set **cookies**.

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# Section

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- The Browser Object Model, BOM
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# The jQuery Library

- ▶ jQuery provides an API that **simplifies** many common JavaScript tasks, like DOM manipulation, CSS manipulation, event handling, effects and animation.

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# The jQuery Library

- ▶ jQuery provides an API that **simplifies** many common JavaScript tasks, like DOM manipulation, CSS manipulation, event handling, effects and animation.
- ▶ There are **many jQuery plugins** that provide more features.

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# The jQuery Library

- ▶ jQuery provides an API that **simplifies** many common JavaScript tasks, like DOM manipulation, CSS manipulation, event handling, effects and animation.
- ▶ There are **many jQuery plugins** that provide more features.
- ▶ jQuery **hides cross-browser issues**, all jQuery code will work the same way in all browsers supporting jQuery.

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# The jQuery Library

- ▶ jQuery provides an API that **simplifies** many common JavaScript tasks, like DOM manipulation, CSS manipulation, event handling, effects and animation.
- ▶ There are **many jQuery plugins** that provide more features.
- ▶ jQuery **hides cross-browser issues**, all jQuery code will work the same way in all browsers supporting jQuery.
- ▶ jQuery is **very commonly used**.

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# Installing jQuery

- ▶ jQuery is a **JavaScript file**, to use it you just have to **provide a link** to that file.

# Installing jQuery

- ▶ jQuery is a [JavaScript file](#), to use it you just have to [provide a link](#) to that file.
- ▶ The jQuery library file comes in two versions:
  - ▶ A [development version](#), which is uncompressed and therefore readable.
  - ▶ A [live website version](#), which has been minified and compressed and therefore is not readable. Instead it is shorter and thereby faster to download.



# Installing jQuery (Cont'd)

- ▶ Either you download it from **jquery.com** and place it on **your server**, or you provide a link to a Content Delivery Network, **CDN**, as follows:

```
<script src="https://cdnjs.cloudflare.com/  
ajax/libs/jquery/1.10.2/jquery.min.js">  
</script>
```

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# Installing jQuery (Cont'd)

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```
<script src="https://cdnjs.cloudflare.com/ajax/libs/jquery/1.10.2/jquery.min.js">
</script>
```

- ▶ Using a CDN is normally faster, since:

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# Installing jQuery (Cont'd)

- ▶ Either you download it from **jquery.com** and place it on **your server**, or you provide a link to a Content Delivery Network, **CDN**, as follows:

```
<script src="https://cdnjs.cloudflare.com/ajax/libs/jquery/1.10.2/jquery.min.js">
</script>
```

- ▶ Using a CDN is normally faster, since:
  - ▶ The file is delivered from the CDNs server **closest to the user**.

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# Installing jQuery (Cont'd)

- ▶ Either you download it from **jquery.com** and place it on **your server**, or you provide a link to a Content Delivery Network, **CDN**, as follows:

```
<script src="https://cdnjs.cloudflare.com/ajax/libs/jquery/1.10.2/jquery.min.js">
</script>
```

- ▶ Using a CDN is normally faster, since:
  - ▶ The file is delivered from the CDNs server **closest to the user**.
  - ▶ Many users already have downloaded jQuery from the CDN when visiting another site. As a result, it is **loaded from browser cache**.

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# The jQuery Function

- ▶ Very central to jQuery is the [jQuery function](#), which has two names, **jQuery** and the commonly used **\$**.

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# The jQuery Function

- ▶ Very central to jQuery is the [jQuery function](#), which has two names, **jQuery** and the commonly used **\$**.
- ▶ Remember that **\$** is a perfectly legal JavaScript identifier, there is nothing magic about that name.

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# The jQuery Function

- ▶ Very central to jQuery is the [jQuery function](#), which has two names, `jQuery` and the commonly used `$`.
- ▶ Remember that `$` is a perfectly legal JavaScript identifier, there is nothing magic about that name.
- ▶ The jQuery function normally takes one parameter, which is either a [CSS selector](#) or a [reference to an object](#) in the document, and returns a jQuery object wrapping all HTML element(s) corresponding to the search criteria.

```
$(document) //The document object.  
$(this)     //The current element.  
$("#someId") //All elements with id "someId"  
$(div)      //All div elements.
```

DOM

BOM

jQuery

AJAX

Long Polling

WebSocket

Knockout

# The jQuery Function

- ▶ Very central to jQuery is the [jQuery function](#), which has two names, **jQuery** and the commonly used **\$**.
- ▶ Remember that **\$** is a perfectly legal JavaScript identifier, there is nothing magic about that name.
- ▶ The jQuery function normally takes one parameter, which is either a [CSS selector](#) or a [reference to an object](#) in the document, and returns a jQuery object wrapping all HTML element(s) corresponding to the search criteria.

```
$(document) //The document object.  
$(this)     //The current element.  
$("#someId") //All elements with id "someId"  
$(div)      //All div elements.
```

- ▶ Any CSS selector can be used as search criteria.

DOM

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# The jQuery Object

- ▶ The **jQuery object** also has two names, **jQuery** and the commonly used **\$**.

[DOM](#)[BOM](#)[jQuery](#)[AJAX](#)[Long Polling](#)[WebSocket](#)[Knockout](#)

# The jQuery Object

- ▶ The `jQuery` object also has two names, `jQuery` and the commonly used `$`.
- ▶ The `jQuery` object contains many methods that operate on the wrapped HTML element. For example the `html` method that gets or sets the HTML content of the wrapped element:

```
/* Store the HTML of the element with
id "someId" in the variable "content". */
var content = $("#someId").html();

/* Set the HTML of the element with
id "someId" to "content<br/>". */
$("#someId").html(content + "<br/>");
```

DOM

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jQuery

AJAX

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# The jQuery Object (Cont'd)

- ▶ The jQuery object supports **array subscripting** via brackets:

```
$("h1")[0]; //The first h1 element.
```

DOM

BOM

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AJAX

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Knockout

# The jQuery Object (Cont'd)

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AJAX

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WebSocket

Knockout

- ▶ The jQuery object supports **array subscripting** via brackets:

```
$("#h1")[0]; //The first h1 element.
```

- ▶ The jQuery object also has **utility methods** that are not related to a HTML element:

```
// Returns the string "extra whitespace"  
$.trim( "  extra whitespace  " );
```

# Event Handlers

- ▶ In jQuery, an event handling function is passed as **argument to a method with the event name** in the jQuery object wrapping the desired event source.

[DOM](#)[BOM](#)[jQuery](#)[AJAX](#)[Long Polling](#)[WebSocket](#)[Knockout](#)

# Event Handlers

- ▶ In jQuery, an event handling function is passed as **argument to a method with the event name** in the jQuery object wrapping the desired event source.
- ▶ The following code adds an event handler to all **<p>** elements. The event handler will change the paragraph's text to **You clicked!** when the user clicks it.

```
$( "p" ).click( function () {  
    $( this ).html ( "You clicked" );  
} );
```

DOM

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# The Document Ready Event

- ▶ jQuery defines the [document ready event](#), which is fired when the DOM has been constructed.

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# The Document Ready Event

- ▶ jQuery defines the **document ready event**, which is fired when the DOM has been constructed.
- ▶ It is usually best to **wait for this event** before running JavaScript code, to avoid operating on elements that have not been defined.

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# The Document Ready Event

- ▶ jQuery defines the [document ready event](#), which is fired when the DOM has been constructed.
- ▶ It is usually best to [wait for this event](#) before running JavaScript code, to avoid operating on elements that have not been defined.
- ▶ It is normally not necessary to wait for the JavaScript load event, which fires when everything, including images, is loaded and rendered.

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# The Document Ready Event

- ▶ jQuery defines the [document ready event](#), which is fired when the DOM has been constructed.
- ▶ It is usually best to [wait for this event](#) before running JavaScript code, to avoid operating on elements that have not been defined.
- ▶ It is normally not necessary to wait for the JavaScript load event, which fires when everything, including images, is loaded and rendered.
- ▶ Therefore, JavaScript code is normally written like this:

```
$(document).ready(function () {  
    // JavaScript code here...  
});
```

[DOM](#)[BOM](#)[jQuery](#)[AJAX](#)[Long Polling](#)[WebSocket](#)[Knockout](#)

# CSS Rules

- ▶ When passed a **CSS property name**, the **css** method returns the value of that property.

```
$ ("body" ).css ("background-color" );
```

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# CSS Rules

- ▶ When passed a **CSS property name**, the **css** method returns the value of that property.

```
$ ("body" ) .css ("background-color" ) ;
```

- ▶ When passed one or more **property:value pairs**, those rules are set for the specified element(s).

```
$ ("body" ) .css ("background-color" , "yellow" ) ;
```

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# Effects

- ▶ There are lots of **effects** provided by jQuery, here are some examples.

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# Effects

- ▶ There are lots of **effects** provided by jQuery, here are some examples.
  - ▶ The **hide** and **show** methods can **hide/show** elements. It is also possible to specify the speed of the (dis)appearance.

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# Effects

- ▶ There are lots of **effects** provided by jQuery, here are some examples.
  - ▶ The **hide** and **show** methods can **hide/show** elements. It is also possible to specify the speed of the (dis)appearance.
  - ▶ Various **fade** methods causes an element to **fade in/out**.

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# Effects

- ▶ There are lots of **effects** provided by jQuery, here are some examples.
  - ▶ The **hide** and **show** methods can **hide/show** elements. It is also possible to specify the speed of the (dis)appearance.
  - ▶ Various **fade** methods causes an element to **fade in/out**.
  - ▶ Various **slide** methods causes an element to **slide up/down**.

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# Effects

- ▶ There are lots of **effects** provided by jQuery, here are some examples.
  - ▶ The **hide** and **show** methods can **hide/show** elements. It is also possible to specify the speed of the (dis)appearance.
  - ▶ Various **fade** methods causes an element to **fade in/out**.
  - ▶ Various **slide** methods causes an element to **slide up/down**.
  - ▶ The **animate** method is used to create custom **animations**.

DOM

BOM

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# Effects (Cont'd)

- ▶ Effects can have **callback functions** that are executed when the effect is done.

```
$("#button").click(function() {  
    $("#p").hide("slow", function() {  
        alert("The paragraph is now hidden");  
    });  
});
```

DOM

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# jQuery Method Chaining

- ▶ Many of the element manipulation methods of the jQuery object **return the jQuery object** itself.

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# jQuery Method Chaining

- ▶ Many of the element manipulation methods of the jQuery object **return the jQuery object** itself.
- ▶ This means it is possible to create **chains** of such methods.

```
$( "button" ).click( function () {  
    $( "#p1" ).css( "color", "blue" )  
        .slideUp( 3000 )  
        .slideDown( 2000 );  
});
```

DOM

BOM

jQuery

AJAX

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# Element Content and Element Attributes

- ▶ The **text** method is used to access [text content](#) of an HTML element, the **html** method is used for text content with [HTML tags](#), the **val** method is used for [form field values](#), and **attr** is used for an element's [attributes](#).

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# Element Content and Element Attributes

- ▶ The `text` method is used to access [text content](#) of an HTML element, the `html` method is used for text content with [HTML tags](#), the `val` method is used for [form field values](#), and `attr` is used for an element's [attributes](#).
- ▶ If called [without arguments](#), these methods return the current value. If called [with arguments](#) they set a new value.

```
$("#btn").click(function() {  
    var current = $("#test").html();  
});
```

```
$("#btn").click(function() {  
    $("#textField").val("New value");  
});
```

DOM

BOM

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AJAX

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# Element Content and Element Attributes (Cont'd)

- ▶ The **text**, **html**, **val**, and **attr** methods can have [callback functions](#).

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# Element Content and Element Attributes (Cont'd)

- ▶ The `text`, `html`, `val`, and `attr` methods can have [callback functions](#).
- ▶ The callback function takes two parameters, the [index](#) of the current element in the list of elements selected and the [original value](#).

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# Element Content and Element Attributes (Cont'd)

- ▶ The `text`, `html`, `val`, and `attr` methods can have [callback functions](#).
- ▶ The callback function takes two parameters, the [index](#) of the current element in the list of elements selected and the [original value](#).
- ▶ The [return value](#) of the callback function becomes the new text of the element.

```
$("#btn").click(function() {  
    $("p").text(function(i, oldText) {  
        return "Old text: " + oldText +  
            ", index: " + i;  
    });  
});
```

DOM

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Knockout

# To Add or Remove Elements

- ▶ The **append**, **prepend**, **before**, and **after** methods are used to **add elements**.

```
// Append a list item to the ordered list
// with id "someList".
$("#someList").
    append("<li>Appended item</li>");
```

DOM

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jQuery

AJAX

Long Polling

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Knockout

# To Add or Remove Elements

- ▶ The **append**, **prepend**, **before**, and **after** methods are used to **add elements**.

```
// Append a list item to the ordered list
// with id "someList".
$("#someList").
    append("<li>Appended item</li>");
```

- ▶ The **remove** and **empty** methods are used to **remove elements**.

```
// Remove the element with id "#menu".
$("#menu").remove();
```

DOM

BOM

jQuery

AJAX

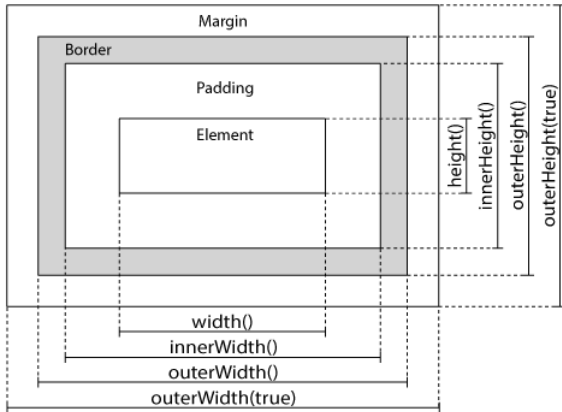
Long Polling

WebSocket

Knockout

# Dimensions

The following image, taken from [http://www.w3schools.com/jquery/jquery\\_dimensions.asp](http://www.w3schools.com/jquery/jquery_dimensions.asp), illustrates the methods used to set or get **element dimensions**.



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# Traversing the DOM Tree

Here are samples of jQuery methods used to traverse the **DOM** tree.

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# Traversing the DOM Tree

Here are samples of jQuery methods used to **traverse the DOM** tree.

**parent** Returns the parent on the nearest higher level.

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# Traversing the DOM Tree

Here are samples of jQuery methods used to **traverse the DOM** tree.

**parent** Returns the parent on the nearest higher level.

**parents** Returns all parents all the way up to the html element.

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# Traversing the DOM Tree

Here are samples of jQuery methods used to **traverse the DOM** tree.

**parent** Returns the parent on the nearest higher level.

**parents** Returns all parents all the way up to the html element.

**children** Returns all children on the nearest lower level.

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# Traversing the DOM Tree

Here are samples of jQuery methods used to traverse the **DOM** tree.

**parent** Returns the parent on the nearest higher level.

**parents** Returns all parents all the way up to the html element.

**children** Returns all children on the nearest lower level.

**find** Returns all descendants on all lower levels.

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# Traversing the DOM Tree

Here are samples of jQuery methods used to traverse the **DOM** tree.

**parent** Returns the parent on the nearest higher level.

**parents** Returns all parents all the way up to the html element.

**children** Returns all children on the nearest lower level.

**find** Returns all descendants on all lower levels.

**siblings** Returns all siblings.

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# Traversing the DOM Tree

Here are samples of jQuery methods used to traverse the **DOM** tree.

**parent** Returns the parent on the nearest higher level.

**parents** Returns all parents all the way up to the html element.

**children** Returns all children on the nearest lower level.

**find** Returns all descendants on all lower levels.

**siblings** Returns all siblings.

**filtering** The **first**, **last**, **eq**, and **filter** methods can be used to filter the search results of the methods above.

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# Question 3

# Section

- The Document Object Model, DOM
- The Browser Object Model, BOM
- The jQuery JavaScript Library
- **AJAX**
- Long Polling
- WebSocket
- The Knockout JavaScript Framework

DOM

BOM

jQuery

**AJAX**

Long Polling

WebSocket

Knockout

# Loading an Entire Page

- ▶ Traditionally, an **entire page is loaded** when the user clicks a link or a button.

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# Loading an Entire Page

- ▶ Traditionally, an **entire page is loaded** when the user clicks a link or a button.
- ▶ Here, to load an entire page means that **all HTML** in the page is read from the server.

DOM

BOM

jQuery

**AJAX**

Long Polling

WebSocket

Knockout

# Loading an Entire Page

- ▶ Traditionally, an **entire page is loaded** when the user clicks a link or a button.
- ▶ Here, to load an entire page means that **all HTML** in the page is read from the server.
- ▶ Dynamic **data is included on the server**, before the HTML is sent to the client, for example using a PHP program.

DOM

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**AJAX**

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WebSocket

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# Loading an Entire Page

- ▶ Traditionally, an **entire page is loaded** when the user clicks a link or a button.
- ▶ Here, to load an entire page means that **all HTML** in the page is read from the server.
- ▶ Dynamic **data is included on the server**, before the HTML is sent to the client, for example using a PHP program.
- ▶ This behavior is appropriate if the entire page content really must change, but that is often **not the case**.

DOM

BOM

jQuery

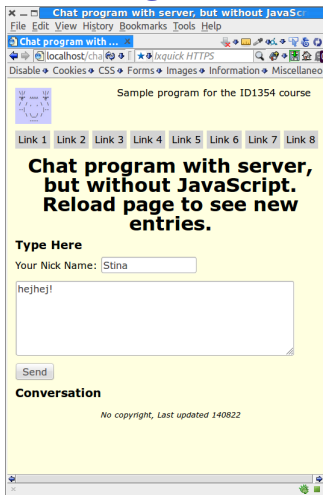
**AJAX**

Long Polling

WebSocket

Knockout

# Loading an Entire Page



Consider for example the sample chat application. **All that happens** when the user clicks **Send** is that the new entry is added, the rest of the page is untouched.

DOM

BOM

jQuery

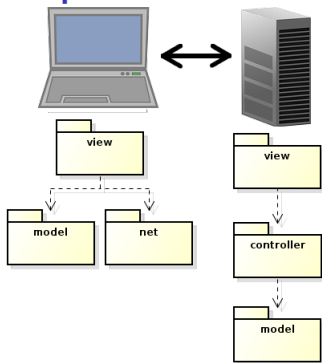
AJAX

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# Repetition: The MVVM Pattern



- ▶ The philosophy behind Model-View-ViewModel, MVVM, is to send **only state changes** from server to client.

DOM

BOM

jQuery

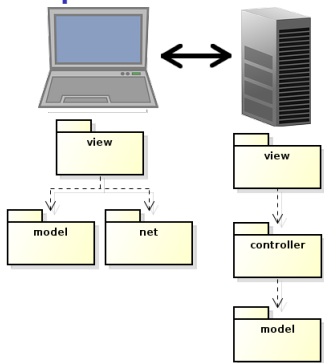
AJAX

Long Polling

WebSocket

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# Repetition: The MVVM Pattern



- ▶ The philosophy behind Model-View-ViewModel, MVVM, is to send **only state changes** from server to client.
- ▶ State changes, which means new data, are **stored in the viewmodel**.

DOM

BOM

jQuery

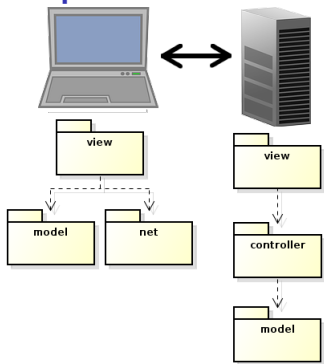
AJAX

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# Repetition: The MVVM Pattern



- ▶ The philosophy behind Model-View-ViewModel, MVVM, is to send **only state changes** from server to client.
- ▶ State changes, which means new data, are **stored in the viewmodel**.
- ▶ Therefore, the viewmodel will always contain the **current state** of the application.

DOM

BOM

jQuery

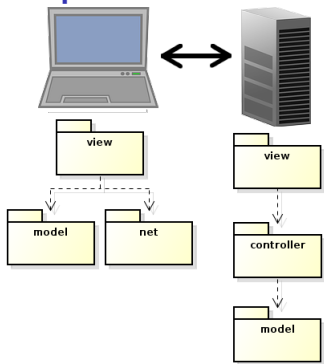
AJAX

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WebSocket

Knockout

# Repetition: The MVVM Pattern



- ▶ The philosophy behind Model-View-ViewModel, MVVM, is to send **only state changes** from server to client.
- ▶ State changes, which means new data, are **stored in the viewmodel**.
- ▶ Therefore, the viewmodel will always contain the **current state** of the application.
- ▶ The browser view must **reflect the viewmodel** state, preferably using the observer pattern.

DOM

BOM

jQuery

AJAX

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# AJAX: To Load Only Data

- ▶ The dominating method to request data from the server, **without reloading** the web page, is **A**synchronous **J**avaScript **A**nd **X**ML, **AJAX**.

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# AJAX: To Load Only Data

- ▶ The dominating method to request data from the server, **without reloading** the web page, is **A**synchronous **J**avaScript **A**nd **X**ML, **AJAX**.
- ▶ AJAX is basically a way to use **existing technologies**, such as JavaScript, HTTP and XML.
  - ▶ No new language or markup.

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# AJAX: To Load Only Data

- ▶ The dominating method to request data from the server, **without reloading** the web page, is **A**synchronous **J**avaScript **A**nd **X**ML, **AJAX**.
- ▶ AJAX is basically a way to use **existing technologies**, such as JavaScript, HTTP and XML.
  - ▶ No new language or markup.
- ▶ The only thing specific for AJAX is a **JavaScript object**, called **XMLHttpRequest**, which is standardized by W3C.

DOM

BOM

jQuery

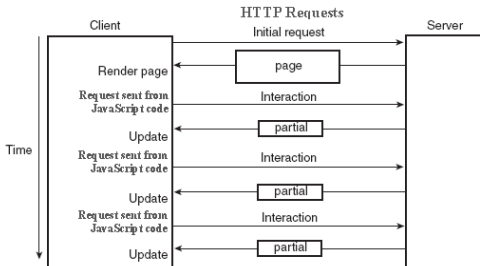
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# How Does It Work?



DOM

BOM

jQuery

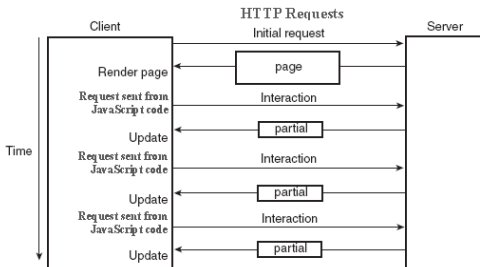
AJAX

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# How Does It Work?



- ▶ Web page is loaded only on **first** request.

DOM

BOM

jQuery

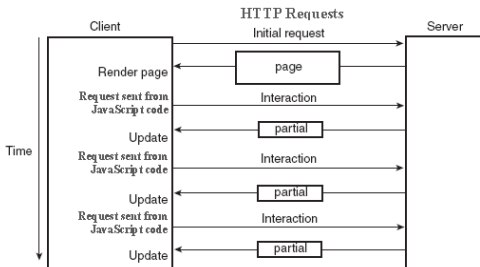
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# How Does It Work?



- ▶ Web page is loaded only on **first** request.
- ▶ **Subsequent requests** come from JavaScript code, using **XMLHttpRequest**.

DOM

BOM

jQuery

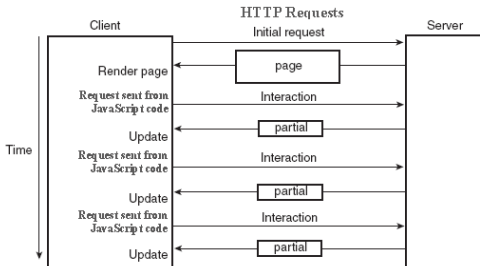
AJAX

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# How Does It Work?



- ▶ Web page is loaded only on **first** request.
- ▶ **Subsequent requests** come from JavaScript code, using **XMLHttpRequest**.
- ▶ The server **returns only data**, no markup.

DOM

BOM

jQuery

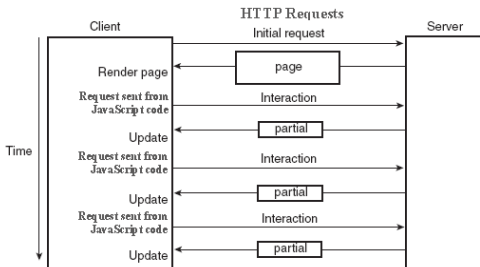
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# How Does It Work?



- ▶ Web page is loaded only on **first** request.
- ▶ **Subsequent requests** come from JavaScript code, using **XMLHttpRequest**.
- ▶ The server **returns only data**, no markup.
- ▶ Returned data is available to JavaScript code, and is used to **update the web page**, by updating the DOM.

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# How Does It Work? (Cont'd)

- ▶ Note that AJAX requests are **ordinary HTTP GET or HTTP POST requests.**

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# How Does It Work? (Cont'd)

- ▶ Note that AJAX requests are **ordinary HTTP GET or HTTP POST requests**.
- ▶ The server directs the request to the **resource specified in the URL**, just as when loading a HTML document.

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# How Does It Work? (Cont'd)

- ▶ Note that AJAX requests are **ordinary HTTP GET or HTTP POST requests**.
- ▶ The server directs the request to the **resource specified in the URL**, just as when loading a HTML document.
- ▶ An AJAX request is normally **handled by a program**, for example PHP, which generates a response containing the new data.

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# Data Format

- ▶ Client and server need to **agree on the format** of the data included in the HTTP response.

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# Data Format

- ▶ Client and server need to **agree on the format** of the data included in the HTTP response.
- ▶ **XML** is an obvious option, but it has some **drawbacks**:

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# Data Format

- ▶ Client and server need to **agree on the format** of the data included in the HTTP response.
- ▶ **XML** is an obvious option, but it has some **drawbacks**:
  - ▶ Interpreting an XML document requires **extra code**.

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# Data Format

- ▶ Client and server need to **agree on the format** of the data included in the HTTP response.
- ▶ **XML** is an obvious option, but it has some **drawbacks**:
  - ▶ Interpreting an XML document requires **extra code**.
  - ▶ Using a XSLT stylesheet to generate a view is a bit **tricky**.

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# Data Format

- ▶ Client and server need to **agree on the format** of the data included in the HTTP response.
- ▶ **XML** is an obvious option, but it has some **drawbacks**:
  - ▶ Interpreting an XML document requires **extra code**.
  - ▶ Using a XSLT stylesheet to generate a view is a bit **tricky**.
  - ▶ XML documents are quite **long and wordy**.

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# Data Format

- ▶ Client and server need to **agree on the format** of the data included in the HTTP response.
- ▶ **XML** is an obvious option, but it has some **drawbacks**:
  - ▶ Interpreting an XML document requires **extra code**.
  - ▶ Using a XSLT stylesheet to generate a view is a bit **tricky**.
  - ▶ XML documents are quite **long and wordy**.
- ▶ Therefore, **JavaScript Object Notation, JSON**, is normally used instead of XML.
  - ▶ **Compact and easy to translate** to JavaScript objects.

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# JSON

- ▶ The **JSON syntax** is very simple:

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# JSON

- ▶ The **JSON syntax** is very simple:
  - ▶ **Data** is name/value pairs:

```
"firstName": "Olle"
```

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# JSON

- ▶ The **JSON syntax** is very simple:
  - ▶ Data is name/value pairs:  
`"firstName": "Olle"`
  - ▶ Data is **separated** by commas.

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BOM

jQuery

AJAX

Long Polling

WebSocket

Knockout

# JSON

- ▶ The **JSON syntax** is very simple:

- ▶ **Data** is name/value pairs:

```
"firstName": "Olle"
```

- ▶ Data is **separated** by commas.
- ▶ **Objects** are denoted with { and }:

```
{"firstName": "Olle", "lastName": "Olsson"}
```

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# JSON

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- ▶ Data is **separated** by commas.
- ▶ **Objects** are denoted with { and }:

```
{"firstName": "Olle", "lastName": "Olsson"}
```

- ▶ **Arrays** are denoted with [ and ]:

```
"employees": [  
  {"firstName": "Olle", "lastName": "Olsson"},  
  {"firstName": "Stina", "lastName": "Nilsson"}  
]
```

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# JSON

- ▶ The **JSON syntax** is very simple:

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```

- ▶ **Arrays** are denoted with [ and ]:

```
"employees": [  
  {"firstName": "Olle", "lastName": "Olsson"},  
  {"firstName": "Stina", "lastName": "Nilsson"}  
]
```

- ▶ Data types are JavaScript types, for example **string**, `"abcd"`; **integer**, `123`; **boolean**, `false`

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# JSON is not an Alternative to XML

- ▶ Note that JSON is **not a general alternative** to XML. There is nothing like namespace, DTD, Schema, XSLT or anything else of all the XML standards.

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# JSON is not an Alternative to XML

- ▶ Note that JSON is **not a general alternative** to XML. There is nothing like namespace, DTD, Schema, XSLT or anything else of all the XML standards.
- ▶ JSON is just a format suitable for transferring **JavaScript values**.

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# The Client: jQuery AJAX Methods

- ▶ Instead of covering the **XMLHttpRequest** object, we will look at some convenient **jQuery functions**.

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# The Client: jQuery AJAX Methods

- ▶ Instead of covering the **XMLHttpRequest** object, we will look at some convenient **jQuery functions**.
- ▶ **getJSON** sends a HTTP GET request. Data can be included as a **query string** and the response is **parsed as JSON data**.

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# The Client: jQuery AJAX Methods

- ▶ Instead of covering the `XMLHttpRequest` object, we will look at some convenient `jQuery` functions.
- ▶ `getJSON` sends a HTTP GET request. Data can be included as a `query string` and the response is `parsed as JSON data`.
- ▶ 

```
$.getJSON(url, "reqData=" + someVariable, function(returnedData) {  
    //Handle returnedData, which is  
    //the received JSON data, parsed  
    //to a JavaScript variable.  
});
```

An HTTP `GET` request is sent to the URL specified in `url`. The request has the `query string` `reqData=<value of someVariable>` and the anonymous `callback function is executed` when the server's response arrives.

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# jQuery AJAX Methods (Cont'd)

- ▶ **post** sends data with a **HTTP POST request**.

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# jQuery AJAX Methods (Cont'd)

- ▶ `post` sends data with a **HTTP POST request**.
- ▶ `$.post(url, "data=" + someVariable);`

An HTTP **POST request** is sent to the URL specified in `url`. The request has the **body data=<value of someVariable>**.

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# jQuery AJAX Methods (Cont'd)

- ▶ **post** sends data with a **HTTP POST request**.
- ▶ `$.post(url, "data=" + someVariable);`

An HTTP **POST request** is sent to the URL specified in `url`. The request has the **body data=<value of someVariable>**.

- ▶ jQuery has **many more** AJAX methods.

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# The Server: JSON handling in PHP

- ▶ Remember that an AJAX request is a normal HTTP request.

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# The Server: JSON handling in PHP

- ▶ Remember that an AJAX request is a normal HTTP request.
- ▶ Therefore, to handle an AJAX request is **no different** from other request handling.

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# The Server: JSON handling in PHP

- ▶ Remember that an AJAX request is a **normal HTTP request**.
- ▶ Therefore, to handle an AJAX request is **no different** from other request handling.
- ▶ What is specific for AJAX interaction, is that we have to generate a **JSON response**.

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# The Server: JSON handling in PHP

- ▶ Remember that an AJAX request is a **normal HTTP request**.
- ▶ Therefore, to handle an AJAX request is **no different** from other request handling.
- ▶ What is specific for AJAX interaction, is that we have to generate a **JSON response**.
- ▶ `json_encode($aPhpObject)`

The **json\_encode** PHP method encodes the PHP object in **aPhpObject** to JSON representation.

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# JSON handling in PHP (Cont'd)

```
class SomeClass implements \JsonSerializable {
    private $some_var;
    ...
    public function jsonSerialize() {
        $json_obj = new stdClass;
        $json_obj->someVar = $this->some_var;
        ...
        return $json_obj;
    }
}
```

- ▶ The object that shall be JSON encoded must be of a class that **implements `JsonSerializable`**.

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# JSON handling in PHP (Cont'd)

```
class SomeClass implements \JsonSerializable {
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```

- ▶ The object that shall be JSON encoded must be of a class that **implements `JsonSerializable`**.
- ▶ That class must have a **method** called **`jsonSerialize`**, which **returns an object** containing all relevant fields.

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# JSON handling in PHP (Cont'd)

```
class SomeClass implements \JsonSerializable {
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    }
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```

- ▶ The object that shall be JSON encoded must be of a class that **implements `JsonSerializable`**.
- ▶ That class must have a **method** called **`jsonSerialize`**, which **returns an object** containing all relevant fields.
- ▶ That returned object must be **possible to encode** with **`json_encode`**.

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# Question 4

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- The Knockout JavaScript Framework

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# Long Polling

- ▶ Long Polling, also called Comet, is a programming technique that enables web servers to **push data to a client** even if the client has not explicitly requested that data.

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# Long Polling

- ▶ Long Polling, also called Comet, is a programming technique that enables web servers to **push data to a client** even if the client has not explicitly requested that data.
1. The browser makes an **Ajax request** to the server, no matter whether there is data to fetch or not.

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# Long Polling

- ▶ Long Polling, also called Comet, is a programming technique that enables web servers to **push data to a client** even if the client has not explicitly requested that data.
1. The browser makes an **Ajax request** to the server, no matter whether there is data to fetch or not.
  2. The request is **left unanswered by the server, until there is data** to send to the browser.

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# Long Polling

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1. The browser makes an **Ajax request** to the server, no matter whether there is data to fetch or not.
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  3. When receiving the server response, the browser **immediately makes a new request** in order to obtain the *next* data set.

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# Long Polling

- ▶ Long Polling, also called Comet, is a programming technique that enables web servers to **push data to a client** even if the client has not explicitly requested that data.
1. The browser makes an **Ajax request** to the server, no matter whether there is data to fetch or not.
  2. The request is **left unanswered by the server, until there is data** to send to the browser.
  3. When receiving the server response, the browser **immediately makes a new request** in order to obtain the *next* data set.
  4. Start over from point one again.

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# Long Polling JavaScript Client

```
$(document).ready(function () {  
    function fetchFromServer () {  
        $.getJSON("get-msg.php",  
            function (response) {  
                $("#fromServer").  
                    prepend("<p>" + response +  
                        "</p>");  
                fetchFromServer ();  
            });  
    }  
  
    fetchFromServer ();  
});
```

Long polling is achieved by the call to **fetchFromServer** in red. This way a new call is made as soon a response has been handled.

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# Long Polling PHP Server

```
1  define("ONE_SEC", 1);
2  define("FILE_PATH", "msg-to-client.txt");
3
4  while (TRUE) {
5      $msg = \file_get_contents(FILE_PATH);
6      if ($msg !== '') {
7          \file_put_contents(FILE_PATH, '');
8          echo \json_encode($msg);
9          return;
10     }
11     \sleep(ONE_SEC);
12 }
```

- ▶ Line eleven pauses execution one second.

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# A Word of Warning

- ▶ The server will not handle multiple simultaneous requests in the same session. If one request is being handled, **other requests in the same session are blocked.**

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# A Word of Warning

- ▶ The server will not handle multiple simultaneous requests in the same session. If one request is being handled, **other requests in the same session are blocked.**
- ▶ Therefore, if the server has started a session, it is best to **stop the session before calling `sleep`.**

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# A Word of Warning

- ▶ The server will not handle multiple simultaneous requests in the same session. If one request is being handled, **other requests in the same session are blocked**.
- ▶ Therefore, if the server has started a session, it is best to **stop the session before calling `sleep`**.

```
\session_write_close();  
\sleep(self::ONE_SEC);  
\session_start();
```

**`session_write_close`** saves session data and closes the session. This is what happens every time a response has been sent, if a session was started.

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- **WebSocket**
- The Knockout JavaScript Framework

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# WebSocket

- ▶ WebSocket is a W3C specification.

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# WebSocket

- ▶ WebSocket is a W3C specification.
- ▶ Specifies a **full-duplex, persistent, TCP connection** between browser and server.

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# WebSocket

- ▶ WebSocket is a W3C specification.
- ▶ Specifies a **full-duplex, persistent, TCP connection** between browser and server.
- ▶ Endpoints are identified by URIs.
  - ▶ `ws://host:port/path` (plain websocket connection)
  - ▶ `wss://host:port/path` (encrypted websocket connection)

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- ▶ Web sockets are message based, endpoints exchange messages (text or binary).

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# WebSocket

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  - ▶ `ws://host:port/path` (plain websocket connection)
  - ▶ `wss://host:port/path` (encrypted websocket connection)
- ▶ Web sockets are message based, endpoints exchange messages (text or binary).
- ▶ A **generic transport service**, like TCP. Just like many connection-oriented protocols are built on top of TCP (HTTP, FTP, POP3, IMAP, etc), there are many message-oriented protocols on top of web sockets.

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# A New Kind of Web?

- ▶ The W3C specification defines a JavaScript endpoint, and is implemented by all major browsers.

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# A New Kind of Web?

- ▶ The W3C specification defines a JavaScript endpoint, and is implemented by all major browsers.
- ▶ There are endpoints for all major server-side technologies, e.g., PHP, Java, .NET, Python, Ruby.

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# A New Kind of Web?

- ▶ The W3C specification defines a JavaScript endpoint, and is implemented by all major browsers.
- ▶ There are endpoints for all major server-side technologies, e.g., PHP, Java, .NET, Python, Ruby.
- ▶ In conclusion, **any browser or server can have a full-duplex connection with any other browser or server.**

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# A New Kind of Web?

- ▶ The W3C specification defines a JavaScript endpoint, and is implemented by all major browsers.
- ▶ There are endpoints for all major server-side technologies, e.g., PHP, Java, .NET, Python, Ruby.
- ▶ In conclusion, **any browser or server can have a full-duplex connection with any other browser or server.**
- ▶ The browser is no longer a just a user interface. It becomes a **node in a network**, that can be programmed (in JavaScript) to do anything, and that can communicate (over websockets) with any other node.

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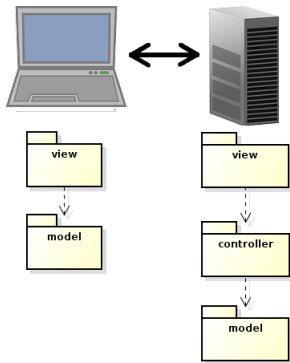
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# Reminder: The MVVM Pattern



- ▶ The MVVM pattern introduces a **client-side model** which **reflects the server-side model** and is responsible for notifying the view of updates.

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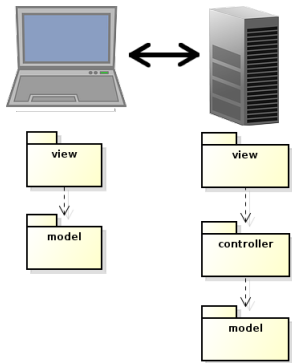
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# Reminder: The MVVM Pattern



- ▶ The MVVM pattern introduces a **client-side model** which **reflects the server-side model** and is responsible for notifying the view of updates.
- ▶ The server-side view is **relieved from creating the HTML**. There will not be PHP in the HTML files!

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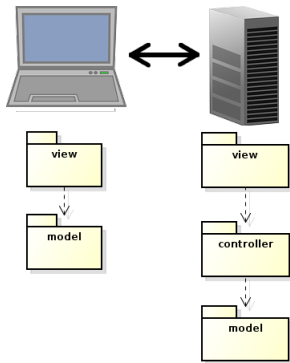
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# Reminder: The MVVM Pattern



- ▶ The MVVM pattern introduces a **client-side model** which **reflects the server-side model** and is responsible for notifying the view of updates.
- ▶ The server-side view is **relieved from creating the HTML**. There will not be PHP in the HTML files!
- ▶ Also, network **communication is reduced**, since only model updates are fetched from the server. There is no need to reload the entire web page at each user action.

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# MVVM JavaScript Frameworks

- ▶ The code for implementing the Observer pattern to have the **view reflect changes in the viewmodel** (and viewmodel reflect changes in the view), will be the same for more or less all applications.

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# MVVM JavaScript Frameworks

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- ▶ Also the code for **viewmodel-to-server communication** will be quite similar in all applications.

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# MVVM JavaScript Frameworks

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- ▶ Also the code for [viewmodel-to-server communication](#) will be quite similar in all applications.
- ▶ This calls for a [client-side framework](#), since we do not want to rewrite the same code for each new application. This is exactly the purpose of [Knockout](#).

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# MVVM JavaScript Frameworks

- ▶ The code for implementing the Observer pattern to have the [view reflect changes in the viewmodel](#) (and viewmodel reflect changes in the view), will be the same for more or less all applications.
- ▶ Also the code for [viewmodel-to-server communication](#) will be quite similar in all applications.
- ▶ This calls for a [client-side framework](#), since we do not want to rewrite the same code for each new application. This is exactly the purpose of [Knockout](#).
- ▶ There are also many alternative frameworks, perhaps the most commonly used is [Backbone](#). Backbone is more used and more powerful than Knockout, but too complicated for this course.

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# The Knockout JavaScript Framework

- ▶ Like jQuery, Knockout is a [JavaScript file](#) that can be linked from a CDN, for example:

```
<script src="https://cdnjs.cloudflare.com/
  ajax/libs/knockout/3.1.0/knockout-min.js">
</script>
```

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# The Knockout JavaScript Framework

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<script src="https://cdnjs.cloudflare.com/ajax/libs/knockout/3.1.0/knockout-min.js">
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- ▶ Knockout should be used [together with jQuery](#), which handles low-level DOM interaction.

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# The Knockout JavaScript Framework

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<script src="https://cdnjs.cloudflare.com/ajax/libs/knockout/3.1.0/knockout-min.js">
</script>
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- ▶ Knockout implements the [MVVM pattern](#), by managing [View-to-Viewmodel bindings](#).

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</script>
```

- ▶ Knockout should be used [together with jQuery](#), which handles low-level DOM interaction.
- ▶ Knockout implements the [MVVM pattern](#), by managing [View-to-Viewmodel bindings](#).
- ▶ The following slides contain a brief introduction to Knockout. For a more extensive guide, see <http://knockoutjs.com/documentation/introduction.html>

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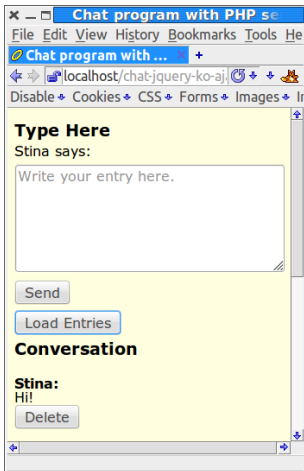
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# The Chat Application

- ▶ To illustrate this Knockout tutorial, we will use the [chat application](#).



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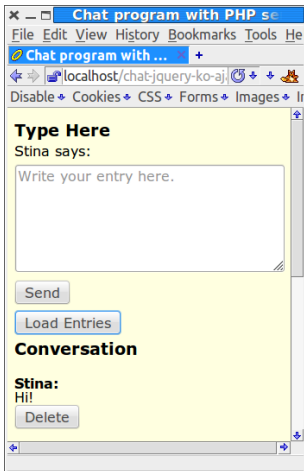
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# The Chat Application



- ▶ To illustrate this Knockout tutorial, we will use the [chat application](#).
- ▶ We will [create a viewmodel](#) that holds the current conversation.

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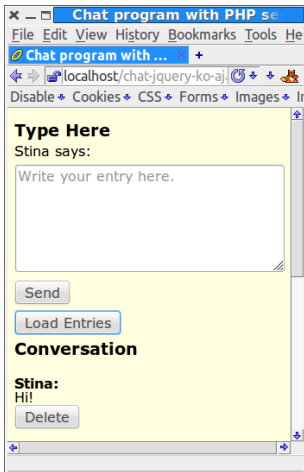
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# The Chat Application



- ▶ To illustrate this Knockout tutorial, we will use the **chat application**.
- ▶ We will **create a viewmodel** that holds the current conversation.
- ▶ The view shall be **updated** as soon as the **viewmodel changes state**.

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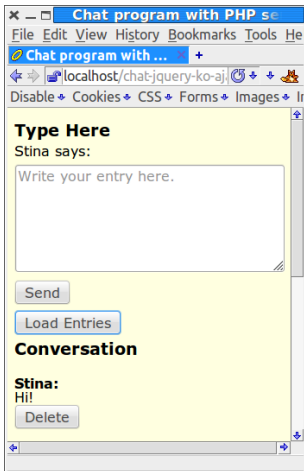
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# The Chat Application



- ▶ To illustrate this Knockout tutorial, we will use the **chat application**.
- ▶ We will **create a viewmodel** that holds the current conversation.
- ▶ The view shall be **updated** as soon as the **viewmodel changes state**.
- ▶ The viewmodel can change state either because the **user wrote an entry** or because another user wrote an entry, which was **loaded from the server** to this user's viewmodel.

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# The Knockout Viewmodel

- ▶ The viewmodel is an ordinary **JavaScript object**, but to make use of Knockout's viewmodel-to-view binding (observer pattern), the properties must be declared as **observables**.

```
function Person(name, age) {  
    var self = this;  
    self.name = ko.observable(name);  
    self.age = ko.observable(age);  
}
```

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# The Knockout Viewmodel

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```
function Person(name, age) {  
    var self = this;  
    self.name = ko.observable(name);  
    self.age = ko.observable(age);  
}
```

- ▶ To read or write a property value, call the property as a function.

```
var olle = new Person("Olle", 35);  
olle.name(); // Returns "Olle"  
olle.age(36); // Sets the age to 36.
```

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# The Chat Application's Viewmodel

- ▶ The Chat's viewmodel has two objects.

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# The Chat Application's Viewmodel

- ▶ The Chat's viewmodel has two objects.
  - ▶ **EntryToAdd** represents a newly written entry that shall be sent to the server.

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# The Chat Application's Viewmodel

- ▶ The Chat's viewmodel has two objects.
  - ▶ **EntryToAdd** represents a newly written entry that shall be sent to the server.
  - ▶ **Conversation** represents the entire conversation.

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# The Chat Application's Viewmodel

- ▶ The Chat's viewmodel has two objects.
  - ▶ **EntryToAdd** represents a newly written entry that shall be sent to the server.
  - ▶ **Conversation** represents the entire conversation.
- ▶ The **EntryToAdd** object has two properties, **nickName** and **msg**

```
function EntryToAdd() {  
    var self = this;  
    self.nickName = ko.observable();  
    self.msg = ko.observable("");  
    ...  
}
```

DOM

BOM

jQuery

AJAX

Long Polling

WebSocket

Knockout



# The Chat Application's Viewmodel (Cont'd)

```
var entryToAdd = new EntryToAdd();  
ko.applyBindings(entryToAdd,  
                 document.getElementById('new-entry'));
```

- ▶ The viewmodel must be [registered with Knockout](#) to enable notifying the observers in the view.

# The Chat Application's Viewmodel (Cont'd)

DOM

BOM

```
var entryToAdd = new EntryToAdd();  
ko.applyBindings(entryToAdd,  
                 document.getElementById('new-entry'));
```

WebSocket

Knockout

- ▶ The viewmodel must be [registered with Knockout](#) to enable notifying the observers in the view.
- ▶ After a JavaScript object has been registered with knockout using the function **applyBindings**, it will always have [the same state](#) as the elements in the DOM.

# The Chat Application's Viewmodel (Cont'd)

```
var entryToAdd = new EntryToAdd();  
ko.applyBindings(entryToAdd,  
                 document.getElementById('new-entry'));
```

- ▶ The viewmodel must be [registered with Knockout](#) to enable notifying the observers in the view.
- ▶ After a JavaScript object has been registered with knockout using the function **applyBindings**, it will always have [the same state](#) as the elements in the DOM.
  - ▶ When the object changes state, the DOM will change state. When the DOM changes state, the object will change state.

# The Chat Application's Viewmodel (Cont'd)

```
var entryToAdd = new EntryToAdd();  
ko.applyBindings(entryToAdd,  
                 document.getElementById('new-entry'));
```

- ▶ The viewmodel must be **registered with Knockout** to enable notifying the observers in the view.
- ▶ After a JavaScript object has been registered with knockout using the function **applyBindings**, it will always have **the same state** as the elements in the DOM.
  - ▶ When the object changes state, the DOM will change state. When the DOM changes state, the object will change state.
- ▶ The second parameter tells to which element in the DOM **entryToAdd** shall be bound. There can only be at most one bound object per element.

# Data Bindings

- ▶ A HTML element in the view is connected to a viewmodel property with a [binding](#).

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# Data Bindings

- ▶ A HTML element in the view is connected to a viewmodel property with a [binding](#).
- ▶ A binding is declared by adding the **data-bind** attribute to the HTML element.

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# Data Bindings

- ▶ A HTML element in the view is connected to a viewmodel property with a [binding](#).
- ▶ A binding is declared by adding the **data-bind** attribute to the HTML element.
- ▶ There are many different types of bindings, like:

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# Data Bindings

- ▶ A HTML element in the view is connected to a viewmodel property with a **binding**.
- ▶ A binding is declared by adding the **data-bind** attribute to the HTML element.
- ▶ There are many different types of bindings, like:

**text** The property value is inserted to the HTML element.

**The message is:**

```
<span data-bind="text: msg"></span>
```

DOM

BOM

jQuery

AJAX

Long Polling

WebSocket

Knockout



# Data Bindings

- ▶ A HTML element in the view is connected to a viewmodel property with a **binding**.
- ▶ A binding is declared by adding the **data-bind** attribute to the HTML element.
- ▶ There are many different types of bindings, like:

**text** The property value is inserted to the HTML element.

```
The message is:  
<span data-bind="text: msg"></span>
```

**visible** Decides if the element is rendered.

```
<div data-bind=  
  "visible: shouldShowMessage">
```

DOM

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AJAX

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Knockout

# Data Bindings

- ▶ A HTML element in the view is connected to a viewmodel property with a **binding**.
- ▶ A binding is declared by adding the **data-bind** attribute to the HTML element.
- ▶ There are many different types of bindings, like:

**text** The property value is inserted to the HTML element.

```
The message is:  
<span data-bind="text: msg"></span>
```

**visible** Decides if the element is rendered.

```
<div data-bind=  
  "visible: shouldShowMessage">
```

**css** Adds or removes CSS classes. The following binding adds the class **warning** if the **profit** property is negative.

```
<div data-bind=  
  "css: {warning: profit () < 0 }">
```

DOM

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Knockout

# Form Field Bindings

There are also bindings for form elements, such as:

**click** Specifies a method that is called when the element is clicked.

```
<button data-bind="click: clickHandler">Click me</button>
```

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# Form Field Bindings

There are also bindings for form elements, such as:

**click** Specifies a method that is called when the element is clicked.

```
<button data-bind="click: clickHandler">Click me</button>
```

**textInput** Binds a text field or text area to a viewmodel property

```
<input type="text" data-bind="textInput: username"/>
```

DOM

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# Form Field Bindings

There are also bindings for form elements, such as:

**click** Specifies a method that is called when the element is clicked.

```
<button data-bind="click: clickHandler">Click me</button>
```

**textInput** Binds a text field or text area to a viewmodel property

```
<input type="text" data-bind="textInput: username"/>
```

**enable** The element is enabled only when the value is **true**

```
Your cellphone number:  
<input type='text' data-bind="textInput: cellphoneNumber, enable: hasCellphone"/>
```

DOM

BOM

jQuery

AJAX

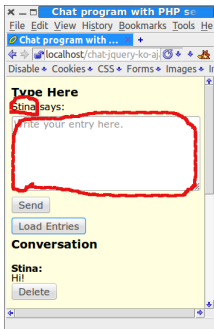
Long Polling

WebSocket

Knockout

# Value Data-Bindings

- ▶ Now let us create the data bindings for the **nick name** text and **msg** text area.



```
<label id="nickNameLabel" for="entry">
  <span data-bind="text: nickName">
  </span>
  says:
</label>

...
<textarea id="entry" rows= 5
  data-bind="textInput: msg"
  placeholder="Write entry here.">
</textarea>
```

DOM

BOM

jQuery

AJAX

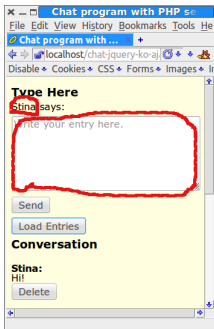
Long Polling

WebSocket

Knockout

# Value Data-Bindings

- ▶ Now let us create the data bindings for the **nick name** text and **msg** text area.



```

<label id="nickNameLabel" for="entry">
  <span data-bind="text: nickName">
    </span>
  says:
</label>

...
<textarea id= "entry" rows = 5
  data-bind="textInput: msg"
  placeholder="Write entry here.">
</textarea>

```

- ▶ Now the **nickname** element and the **nickName** property in the **EntryToAdd** object will **always** have the same value.

DOM

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AJAX

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Knockout

# Value Data-Bindings

- ▶ Now let us create the data bindings for the **nick name** text and **msg** text area.

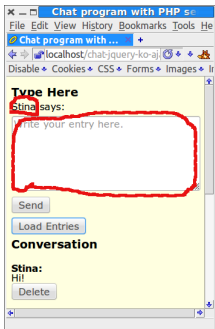
```

<label id="nickNameLabel" for="entry">
  <span data-bind="text: nickName">
    </span>
  says:
</label>
...
<textarea id="entry" rows=5
  data-bind="textInput: msg"
  placeholder="Write entry here.">
</textarea>

```

- ▶ Now the **nickname** element and the **nickName** property in the **EntryToAdd** object will **always** have the same value.

- ▶ Also, the text in the textarea will **always be the same** as the value of the **msg** property.



DOM

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jQuery

AJAX

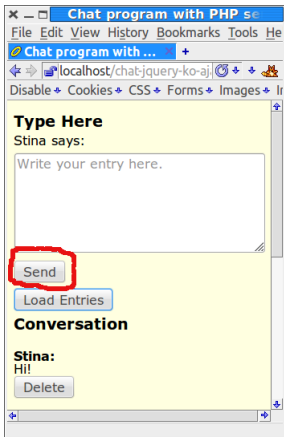
Long Polling

WebSocket

Knockout



# Click Data-Bindings



```
<button data-bind="click: sendEntry">  
  Send  
</button>
```

- ▶ Then let us create the data-binding for the **Send** button.

DOM

BOM

jQuery

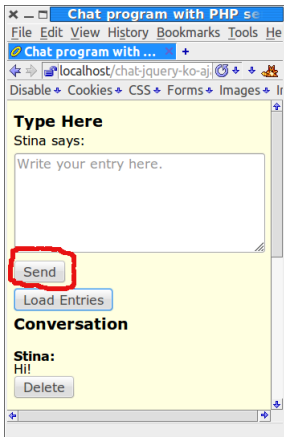
AJAX

Long Polling

WebSocket

Knockout

# Click Data-Bindings



```
<button data-bind="click: sendEntry">  
  Send  
</button>
```

- ▶ Then let us create the data-binding for the **Send** button.
- ▶ Here we specified that the **sendEntry** method is called when the user clicks the button.

DOM

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Knockout

# The `sendEntry` Method

```
1 self.sendEntry = function () {
2     if (self.msg() !== "") {
3         $.post(writeUrl,
4             "msg=" + ko.toJS(self.msg));
5         self.msg("");
6     }
7 };
```

- ▶ Line 2 checks that the user has typed a message.

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# The `sendEntry` Method

```
1 self.sendEntry = function () {
2     if (self.msg() !== "") {
3         $.post(writeUrl,
4             "msg=" + ko.toJS(self.msg));
5         self.msg("");
6     }
7 };
```

- ▶ Line 2 checks that the user has typed a message.
- ▶ Lines 3-4 sends the new entry to the server in a HTTP **post** request.

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# The `sendEntry` Method

```
1 self.sendEntry = function () {
2     if (self.msg() !== "") {
3         $.post(writeUrl,
4             "msg=" + ko.toJSON(self.msg));
5         self.msg("");
6     }
7 };
```

- ▶ Line 2 checks that the user has typed a message.
- ▶ Lines 3-4 sends the new entry to the server in a HTTP `post` request.
- ▶ The call to `ko.toJSON` on line 4 converts the message to JSON format.

DOM

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AJAX

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Knockout

# The `sendEntry` Method

```
1 self.sendEntry = function () {
2     if (self.msg() !== "") {
3         $.post(writeUrl,
4             "msg=" + ko.toJSON(self.msg));
5         self.msg("");
6     }
7 };
```

- ▶ Line 2 checks that the user has typed a message.
- ▶ Lines 3-4 sends the new entry to the server in a HTTP `post` request.
- ▶ The call to `ko.toJSON` on line 4 converts the message to JSON format.
- ▶ Line 5 clears the text area.

DOM

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Knockout

# Read Nickname From Server

- ▶ One question remains, how did the nickname show up correctly in the view? Note that it is not inserted in php code on the server (very good!):

```
<label id="nickNameLabel" for="entry">  
  <span data-bind="text: nickName">  
  </span>  
  says:  
</label>
```

DOM

BOM

jQuery

AJAX

Long Polling

WebSocket

Knockout

# Read Nickname From Server

- ▶ One question remains, how did the nickname show up correctly in the view? Note that it is not inserted in php code on the server (very good!):

```
<label id="nickNameLabel" for="entry">
  <span data-bind="text: nickName">
    </span>
  says:
</label>
```

- ▶ The answer is that the nickname was read in an extra AJAX call from the **EntryToAdd** constructor.

```
function EntryToAdd() {
  var self = this;
  self.nickName = ko.observable();
  ...
  $.getJSON(nickNameUrl, function (username) {
    self.nickName(username);
  });
}
```

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# Read Nickname From Server (Cont'd)

- ▶ The ajax call on the previous slide is handled by the **GetUsername** request handler (code below is not complete).

```
class GetUsername extends AbstractRequestHandler {  
  
    protected function doExecute() {  
        $this->addVariable('jsonData',  
                           $contr->getUsername());  
        return 'json-view';  
    }  
  
}
```

DOM

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Knockout

# Read Nickname From Server (Cont'd)

- ▶ The ajax call on the previous slide is handled by the **GetUsername** request handler (code below is not complete).

```
class GetUsername extends AbstractRequestHandler {  
  
    protected function doExecute() {  
        $this->addVariable('jsonData',  
                           $contr->getUsername());  
        return 'json-view';  
    }  
  
}
```

- ▶ **json-view.php** just echos the value of **\$jsonData**.

```
echo \json_encode($jsonData);
```

DOM

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# The **C**onversation object in the viewmodel

- ▶ Now we have covered everything in the **EntryToAdd** object in the viewmodel.

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# The **C**onversation object in the viewmodel

- ▶ Now we have covered everything in the **E**ntry**T**o**A**dd object in the viewmodel.
- ▶ There is one more object in the viewmodel, **C**onversation, which contains the entire chat conversation.

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# The **C**onversation object in the viewmodel

- ▶ Now we have covered everything in the **EntryToAdd** object in the viewmodel.
- ▶ There is one more object in the viewmodel, **C**onversation, which contains the entire chat conversation.
- ▶ **C**onversation has a property, **e**ntries that holds an array of all conversation entries.

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# The **C**onversation object in the viewmodel

- ▶ Now we have covered everything in the **EntryToAdd** object in the viewmodel.
- ▶ There is one more object in the viewmodel, **C**onversation, which contains the entire chat conversation.
- ▶ **C**onversation has a property, **e**ntries that holds an array of all conversation entries.
- ▶ To understand how that works, we must look at how knockout binds arrays to elements in the DOM.

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# Observable Arrays

- ▶ To observe an [array](#), use **observableArray**.

```
var myObservableArray = ko.observableArray();
```

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# Observable Arrays

- ▶ To observe an `array`, use `observableArray`.

```
var myObservableArray = ko.observableArray();
```

- ▶ The `entries` property in `Conversation` is an `observableArray` and holds an array of objects having the two properties `nickName` and `msg`

```
function Conversation(entryToAdd) {  
    var self = this;  
    ...  
    self.entries = ko.observableArray();  
    ...  
}
```

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# Flow Control Data-Bindings

- ▶ When binding **entries** to the DOM, we must use the **flow control data bindings** **if** and **foreach**.  
Let's first have a look at those.

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# Flow Control Data-Bindings

- ▶ When binding **entries** to the DOM, we must use the **flow control data bindings** **if** and **foreach**. Let's first have a look at those.
- ▶ **foreach** binds each element to in an array to the DOM.

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# Flow Control Data-Bindings

- ▶ When binding **entries** to the DOM, we must use the **flow control data bindings** **if** and **foreach**. Let's first have a look at those.
- ▶ **foreach** binds each element to in an array to the DOM.
- ▶ Whenever elements are **added, removed, or re-ordered** in a bound observable array, the DOM will be updated to reflect the new array contents.

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# foreach Data-Binding (Cont'd)

Assuming **people** is a JavaScript array of objects with **firstName** and **lastName** properties, the following generates a table with one object per row.

```
<table>
  <thead>
    <tr><th>First name</th>
    <th>Last name</th></tr>
  </thead>
  <tbody data-bind="foreach: people">
    <tr>
      <td data-bind="text: firstName"></td>
      <td data-bind="text: lastName"></td>
    </tr>
  </tbody>
</table>
```

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# foreach Data-Binding (Cont'd)

- ▶ The current array element is referred using **\$data**

```
<ul data-bind="foreach: months">
  <li>
    <span data-bind="text: $data"></span>
  </li>
</ul>
```

DOM

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# foreach Data-Binding (Cont'd)

- ▶ The current array element is referred using `$data`

```
<ul data-bind="foreach: months">
  <li>
    <span data-bind="text: $data"></span>
  </li>
</ul>
```

- ▶ **as** gives an alias to the current array element.

```
<ul data-bind=
  "foreach: { data: categories, as: 'category' }">
  <li>
    <ul data-bind=
      "foreach: { data: items, as: 'item' }">
      <li>
        <span data-bind="text: category.name">
        </span>:
        <span data-bind="text: item"></span>
      </li>
    </ul>
  </li>
</ul>
```

DOM

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Knockout

# Containerless Control Flow Syntax

- ▶ If there is no containing element for the data-binding, use the [containerless syntax](#), based on HTML comment tags.

```
<!-- ko foreach: {data:items, as:'item'} -->  
  <p>  
    <span data-bind="text:item.price">  
      </span>  
  </p>  
<!-- /ko -->
```

DOM

BOM

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AJAX

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Knockout

# Containerless Control Flow Syntax

- ▶ If there is no containing element for the data-binding, use the **containerless syntax**, based on HTML comment tags.

```
<!-- ko foreach: {data:items, as:'item'} -->  
  <p>  
    <span data-bind="text:item.price">  
    </span>  
  </p>  
<!-- /ko -->
```

- ▶ An **if** data-binding displays the enclosed elements **only** if the condition is true.

```
<!-- ko if: item.isOffer -->  
  <p>  
    Offer!  
  </p>  
<!-- /ko -->
```

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# The Conversation Data-Binding

- Now we can create the data binding for the **conversation part** of the chat application (code is not complete).

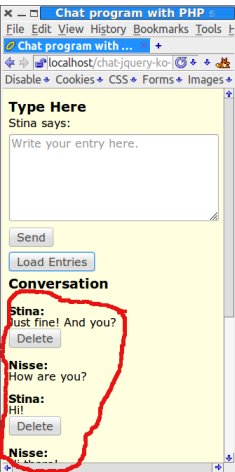
DOM

BOM

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```

<!-- ko foreach: {data: entries, as: 'entry'} -->
  <p>
    <span data-bind='text: entry.nickName'></span>:
  </p>
  <!-- ko foreach: entry.msg -->
    <p>
      <span data-bind='text: $data'></span>
    </p>
  <!-- /ko -->
  <!-- ko if: entry.iWroteThisEntry -->
    <p>
      <button data-bind=
        'click: $parent.deleteEntry'>
        Delete
      </button>
    </p>
  <!-- /ko -->
<!-- /ko -->

```

# The Conversation Data-Binding

- ▶ Now we can create the data binding for the **conversation part** of the chat application (code is not complete).
- ▶ The inner loop is needed for multi-line messages.

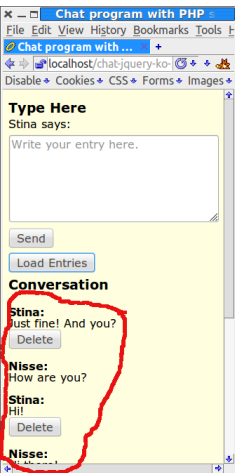
DOM

BOM

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```

<!-- ko foreach: {data: entries, as: 'entry'} -->
  <p>
    <span data-bind='text: entry.nickName'></span>:
  </p>
  <!-- ko foreach: entry.msg -->
    <p>
      <span data-bind='text: $data'></span>
    </p>
  <!-- /ko -->
  <!-- ko if: entry.iWroteThisEntry -->
    <p>
      <button data-bind=
        'click: $parent.deleteEntry'>
        Delete
      </button>
    </p>
  <!-- /ko -->
<!-- /ko -->

```

# No PHP! (Almost)

- ▶ That was all, now we have seen an **overview of some features** in Knockout, and also created the chat application.

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# No PHP! (Almost)

- ▶ That was all, now we have seen an **overview of some features** in Knockout, and also created the chat application.
- ▶ As a result, there is now **no PHP code** left in the html files!

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# No PHP! (Almost)

- ▶ That was all, now we have seen an **overview of some features** in Knockout, and also created the chat application.
- ▶ As a result, there is now **no PHP code** left in the html files!
  - ▶ Except for including fragments and creating link paths.

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# Without JavaScript framework

Without a JavaScript framework that handles viewmodel-to-DOM bindings, where would we store the nickname and chat conversation? There are three options, each with **serious drawbacks**.

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# Without JavaScript framework

Without a JavaScript framework that handles viewmodel-to-DOM bindings, where would we store the nickname and chat conversation? There are three options, each with **serious drawbacks**.

1. **Write the JavaScript code that is now in the framework.** This means quite a lot of quite tricky handling of the DOM, knockout.js contains thousands of lines of JavaScript code.

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# Without JavaScript framework

Without a JavaScript framework that handles viewmodel-to-DOM bindings, where would we store the nickname and chat conversation? There are three options, each with **serious drawbacks**.

1. **Write the JavaScript code that is now in the framework.** This means quite a lot of quite tricky handling of the DOM, knockout.js contains thousands of lines of JavaScript code.
2. **Do not create a viewmodel**, but store the data only in the DOM. This is the case in the chat example without knockout on the course web. Even for this small program it means quite a lot of searching through HTML elements and parsing string.

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# Without JavaScript framework

Without a JavaScript framework that handles viewmodel-to-DOM bindings, where would we store the nickname and chat conversation? There are three options, each with **serious drawbacks**.

1. **Write the JavaScript code that is now in the framework.** This means quite a lot of quite tricky handling of the DOM, knockout.js contains thousands of lines of JavaScript code.
2. **Do not create a viewmodel,** but store the data only in the DOM. This is the case in the chat example without knockout on the course web. Even for this small program it means quite a lot of searching through HTML elements and parsing string.
3. **Store data only on the server.** This means there is no JavaScript client at all, and we are back to reloading the entire page whenever the user does something.

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