Multimedia im Netz
Online Multimedia

Wintersemester 2015/2016

Part I

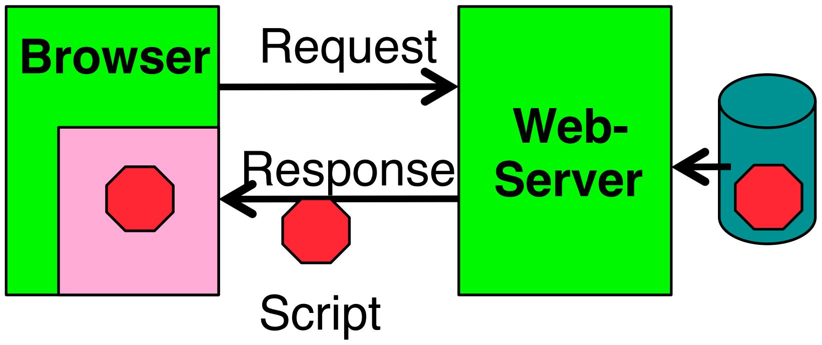
Web Technologies for Interactive Multimedia

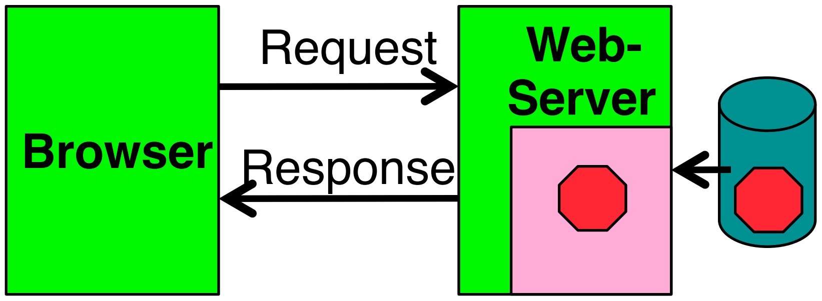
Chapter 2: Interactive Web Applications

Dynamic Web Contents

- Content shown to user in browser is dependent on some external variables
- Examples of external variables:
  - Date and time
  - Contents of an information archive (e.g. recent news)
  - Actions of the user
    - » Pointing to elements
    - » Clicking at a certain position
    - » Filling out forms
- Wide-spread applications:
  - E-Commerce
  - Interpersonal communication media (forums, discussion boards)
  - Mass media (news and other information services)

Server-Side vs. Client-Side Realisation

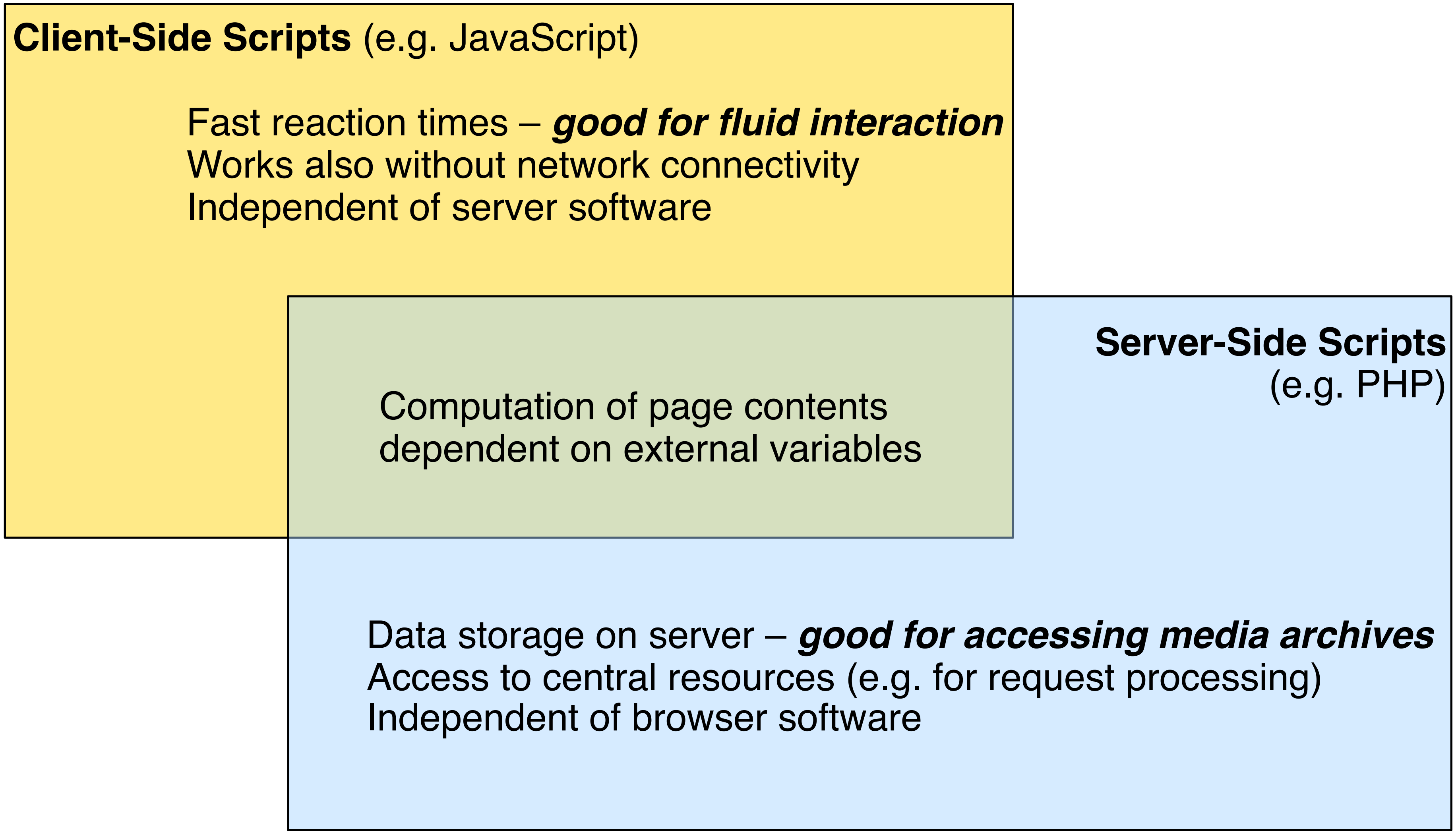




- Client-side realization:
  - Browser contains execution engine for scripts
  - Web server does not need to execute scripts
  - Script is sent to client as part of server response
  - Example: JavaScript

- Server-side realization:
  - Web server contains execution engine for scripts
  - Browser does not need to execute scripts
  - Script is executed on server and computes response to client
  - Example: PHP

Server Scripts vs. Client Scripts



Client-Side Scripts (e.g. JavaScript)

Fast reaction times – ***good for fluid interaction***
Works also without network connectivity
Independent of server software

Computation of page contents
dependent on external variables

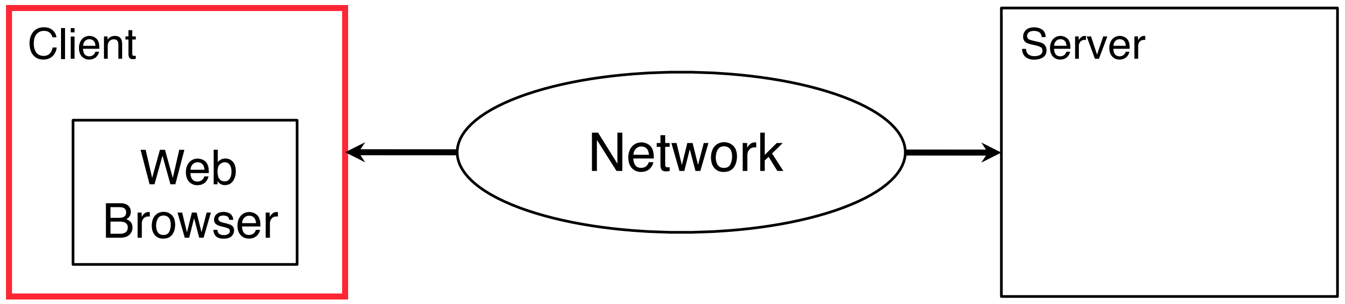
Server-Side Scripts
(e.g. PHP)

Data storage on server – ***good for accessing media archives***
Access to central resources (e.g. for request processing)
Independent of browser software

Web Architectures for Interactivity

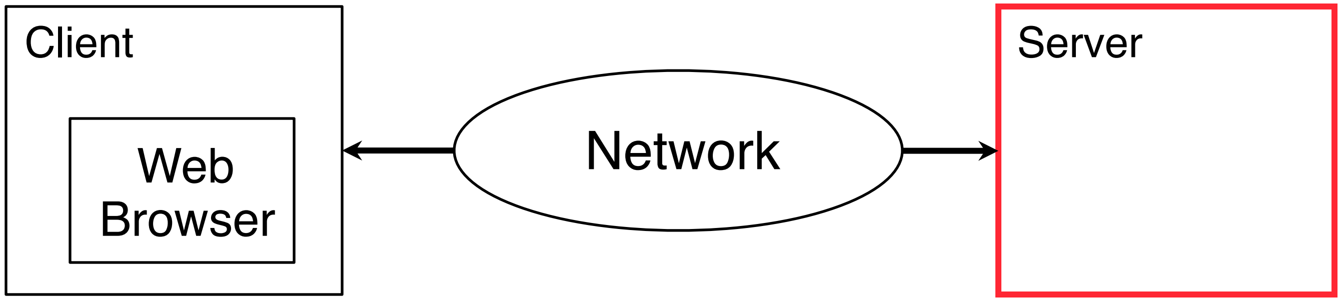
- Early approaches: “Common Gateway Interface (CGI)”
  - Informally defined, programs invoked to create HTML code
  - Drawbacks: Security problems, high processor load (separate process)
- Later: Web server software add-ons
  - Interfaces to common scripting and programming languages
    e.g. *Java, Perl*, *Ruby*, *PHP*
  - Scripting languages specifically designed for Web development
    e.g. *PHP*
- Web server software integrated with specific execution environments (“Application Server”)
  - Complex, highly optimized for good throughput
  - e.g. Servers for Java Enterprise Edition, Microsoft .NET framework
- Trend: Web servers written in I/O-efficient languages
  - e.g. *Express* server written in JavaScript (Node.js)

Media Support – Functions of Client Only



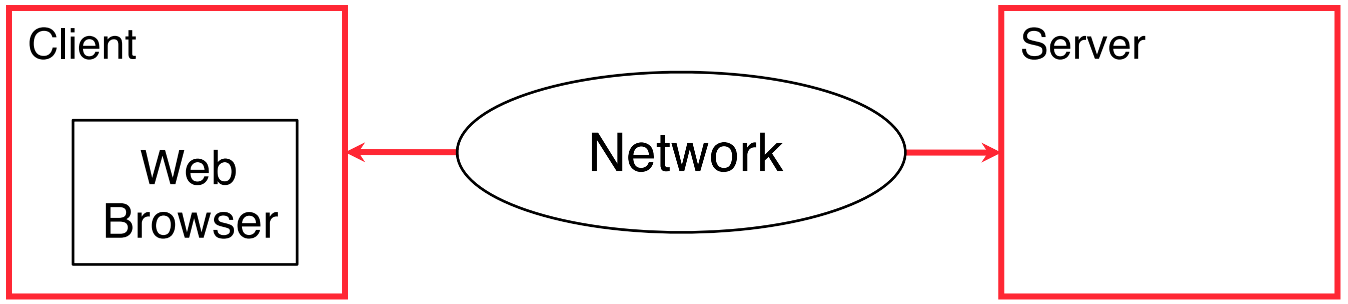
- Media rendering:
  - Recognition of media file types
    - » MIME registry of browser
  - Local media playing software
    - » Plugins or separate programs
- Interactivity:
  - Local interactions
    - » Highlighting, dynamic menus etc.

Media Support – Functions by Server Only



- Media rendering:
  - Storage of media files and meta-information
  - Indexing and querying
- Interactivity:
  - Interactions with server-side effect
    - » E.g. database updates (registration, buying, ...)
  - Interactions with global effect for all users
    - » E.g. adding a comment, uploading a video

Media Support – Functions by Client & Server



- Media streaming:
  - Playback of incomplete content in client
  - Play-out in defined order from server
  - Synchronization, rate control, buffering
  - Flow control (stop, start, pause)
  - Adaptation to network conditions
- Interactivity:
  - Near real-time interactions
    - » E.g. status notifications, data ticker

Chapter 2: Interactive Web Applications

Literature:

B. Lawson, R. Sharp: Introducing HTML5, New Riders 2011
S. Fulton, J. Fulton: HTML5 Canvas, 2nd ed., O'Reilly 2013

Embedding Media in HTML

- Media embedding requires:
  - Media data (a file)
  - Player software
- Typical media data:
  - Sound files (e.g. .wav, .mp3, .ogg, .opus, .midi)
  - Movie files (e.g. .avi, .mov, .mp4, .ogv, .flv)
  - Programs to be executed on a virtual machine ("universal player"), e.g.:
    - » Java applets
    - » Flash runtime code (Shockwave Flash, .swf)
    - » Silverlight application packages (.xap)
- Browser integration:
  - Built-in: Browser "knows" about player for media type
  - Plug-in: Flexible association between player and media type
- Incompatibilities in older versions of HTML
  - **`embed`** by Netscape, **`object`** by W3C & Microsoft, strange combinations!

HTML 5

- HTML Version 5
  - Draft W3C standard (proposed recommendation 16 September 2014)
  - Developed in parallel to XHTML 1.0
    - » XHTML 2.0 development has been stopped
    - » XML representation of HTML5 exists ("DOM5")
- HTML 5 is partially supported already by most modern browsers
- HTML 5 contains standardized and simple media embedding tags
  - audio
  - video
  - embed

Audio Embedding in HTML 5

- Example:

```
<html> …
  <body>
    ...
    <audio src="nightflyer.ogg" autoplay>
      Your browser does not support the <code>audio</code> element.
    </audio>
```

- Attributes (examples):
  - autoplay: Playback starts automatically
  - controls: Control UI elements are made visible
  - loop: Plays in an endless loop
  - preload: Hints about preloading expectations
- Subelement <source>:
  - Alternative way to specify data source
  - Multiple occurrence is possible, first supported version is taken

Video Embedding in HTML 5

- Example:

```
<html>
  <body>
    <video controls>
       <source src="big_buck_bunny_480p_stereo.ogg" type="video/ogg">
       <source src="big_buck_bunny_480p_h264.mov" type="video/quicktime">
          Your browser does not support the <code>video</code> element.
    </video>
```

- Additional Attributes compared to <audio> (examples):
  - height, width: Dimensions of video image
  - poster: Image to be shown until first frame becomes available
- Events (can be handled e.g. with JavaScript, examples):
  - empty
  - canplay
  - ended
  - abort
  - volumechange

`<embed>` in HTML 5

- HTML 5 contains a standardized version of the **`<embed>`** element
- Purpose:
  - Embed arbitrary content played back via plug-in software
- Examples:
  - Flash content
  - Java applets
- Not intended for media playback

Video Codecs and HTML5 Video

- HTML5 Working Group: All browsers should support at least one common video format
  - Good quality & compression, hardware-supported, royalty-free!
- Problems with mainstream formats:
  - Patents on H.264 and its successor HEVC/H.265
  - Fear of hidden patents for Ogg Theora
- Google:
  - Release of WebM to the public (after purchase of On2)
  - WebM container format based on Matroska container, open, royalty-free
  - VP8 video Vorbis audio (current), VP9 video format with Opus audio
  - VP10 in preparation
- Patent battle between Google and Nokia on VP8
- Still no simple common solution for the key manufacturers available
  - Neither H.264 nor VP8 fully supported by all browsers on all platforms
  - H.264 appears to be in the best position currently

Client-Side Interactivity with HTML5

- Browser-executed scripting languages
  - JavaScript, mainly
- Processing of user input
  - Event handling for mouse and keyboard input
  - Additional controls
- 2D graphics drawing
  - **`canvas`** element
- Animations
  - JavaScript frameworks, e.g. jQuery or JSCreate

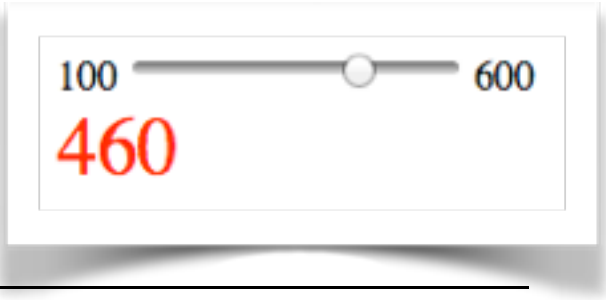
HTML5 Interactive Controls

- Standard controls for interactive applications have been integrated into HTML5
  - “range” element (slider control)
  - “color” element (interactive color picker)
- Potential:
  - Higher client-side (stand-alone) interactivity
  - Typical applications: Drawing, image editing
  - See discussion of “canvas” element below

Example: Slider in HTML5

slider.html

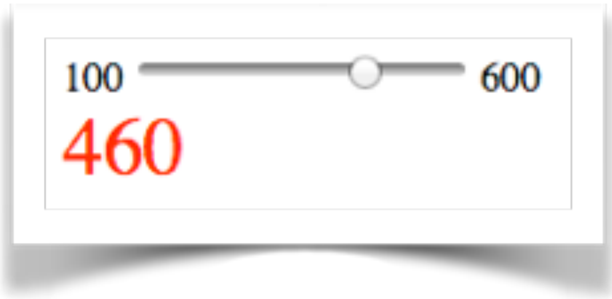
```
<!DOCTYPE html>

<html>
  <head>
     <title>Slider in HTML5</title>
     <style type="text/css">
        input[type=range]::before {content: attr(min)}
        input[type=range]::after {content: attr(max)}
        input[type=range]
           {width:500px; color:red; font-size:1.5em;}
      </style>
  </head>
  <body oninput="current.value=slider.value">
    <input name="slider" type="range"
       min="100" max="600" step="10"/>
    <output name="current">420</output>
  </body>
</html>
```



Example: Slider in HTML5, mit JavaScript

slider.html

```
<!DOCTYPE html>
<html>
  <head>…</head>
  <body>
    <output id="min_val"></output>
    <input type="range" id="slider"
          min="100" max="600" step="10"/>
    <output id="max_val"></output></br>
    <output id="cur_val"
          style="color:red; font-size:200%;"></output>
    <script type="text/javascript">
      document.addEventListener("DOMContentLoaded", function(){
          min_val.value = slider.min;
          max_val.value = slider.max;}, false);
      slider.addEventListener("change", function(){
          cur_val.value = slider.value;}, false);
    </script>
  </body>
</html>
```

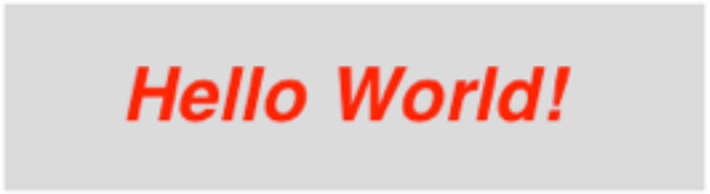


HTML5 Canvas

- "HTML5 Canvas is an *immediate mode* bitmapped area of the screen that can be manipulated with JavaScript." (Fulton/Fulton)
- *2D Drawing Context:*
  - Object associated with a Canvas object
  - Used as handler in JavaScript to address the canvas (drawing API)
- Typical drawing primitives:
  - Draw shapes
  - Render text
  - Display images
  - Apply colors, rotations, transparency, pixel manipulations, fills, strokes
- (Pure) Canvas works on (low) pixel level
  - Browser redraws whole canvas each time the Canvas is modified using JavaScript
  - "Retained mode" rendering is provided by JavaScript libraries (e.g. EaselJS, part of CreateJS, see http://www.createjs.com)

Example: Drawing on the Canvas

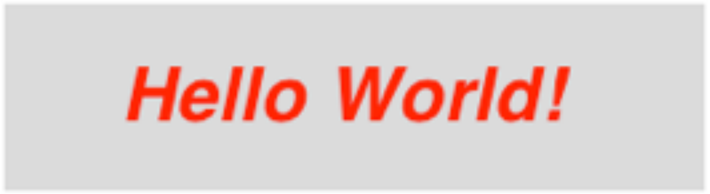
```
<!doctype html>
<html>
<head>
   <title>Canvas Hello World</title>

   <script type="text/javascript">
    window.addEventListener("load", drawScreen, false);
    function drawScreen() {
        var c = document.getElementById("theCanvas");
        var ctx = c.getContext("2d");
        ctx.fillStyle = "lightgrey";
        ctx.fillRect(0, 0, c.width, c.height);
        ctx.font = "italic bold 32px sans-serif";
        ctx.fillStyle = "red";
        ctx.fillText("Hello World!", 50, 50);
    }
   </script>
</head>
<body>
   <canvas id="theCanvas" width=300 height=80>
        Your browser does not support Canvas!
   </canvas>
</body>
</html>
```



canvashello.html

Example: Drawing on the Canvas

```
<!doctype html>
<html>
<head>
    <title>Canvas Hello World</title>

    <script type="text/javascript">
     window.addEventListener("load", function() {
         var c = document.getElementById("theCanvas");
         var ctx = c.getContext("2d");
         ctx.fillStyle = "lightgrey";
         ctx.fillRect(0, 0, c.width, c.height);
         ctx.font = "italic bold 32px sans-serif";
         ctx.fillStyle = "red";
         ctx.fillText("Hello World!", 50, 50);
     }, false);
    </script>
</head>
<body>
    <canvas id="theCanvas" width=300 height=80>
         Your browser does not support Canvas!
    </canvas>
</body>
</html>
```



canvashello1.html

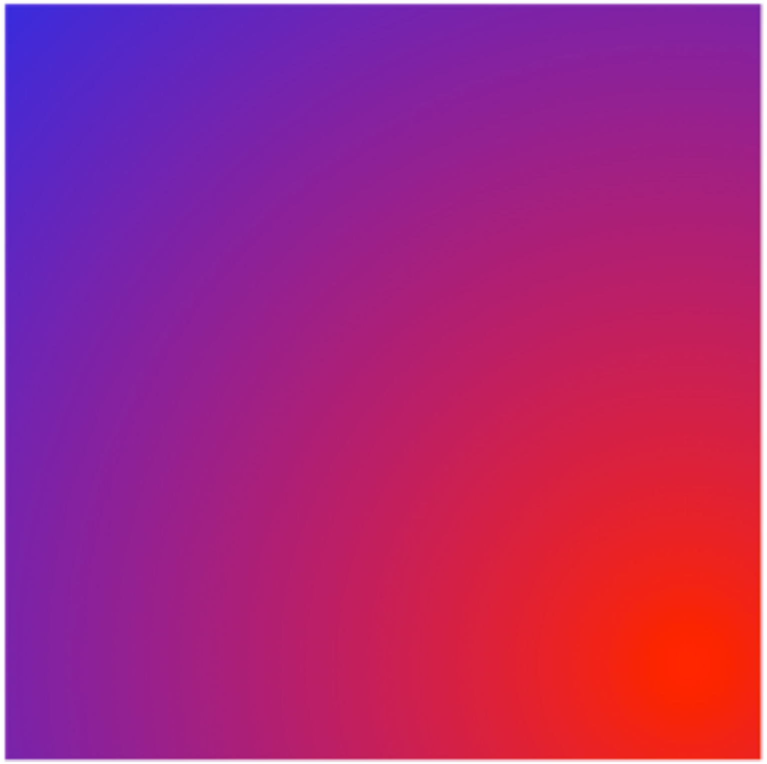
Example: Interactive Gradient (1)

```
<!doctype html>

<html>
<head>
     <title>Canvas Gradient Fill</title>
     <meta charset="UTF-8">

     <script type="text/javascript">
       window.addEventListener("mousemove", drawScreen, false);
       function drawScreen(event) {
         var c = document.getElementById("theCanvas");
         var ctx = c.getContext("2d");
         var mx = Math.min(event.clientX, c.width);
         var my = Math.min(event.clientY, c.height);
         var grad =
           ctx.createRadialGradient(mx, my, 0, mx, my, c.width*1.5);
         grad.addColorStop(0,"#f00");
         grad.addColorStop(1,"#00f");
         ctx.fillStyle = grad;
         ctx.fillRect(0, 0, c.width, c.height);
       }
     </script>
</head>
```

gradient.html

Example: Interactive Gradient (2)

```
...

<body>
     <canvas id="theCanvas" width=500 height=500>
          Your browser does not support Canvas!
     </canvas>
</body>
</html>
```



Chapter 2: Interactive Web Applications

Server-Side Script Language PHP

(Only an example for a server-side script language!)

- PHP:
  - **P**ersonal **H**ome **P**age Toolkit
    - » 1995, Rasmus Lerdorf
    - » 2003, new by Zeev Suraski, Andi Gutmans
  - **P**HP **H**ypertext **P**reprocessor (recursive acronym, backronym)
- Current version: 5.6.14 (October 2015) [version 7 in preparation]
- OpenSource project:
  - see www.php.net
  - Can be used and modified freely (PHP license)
- Syntax loosely oriented towards C
  - Variations of possible syntax
- Extensive function library
  - being extended by community
- Advanced and popular Web development frameworks based on PHP

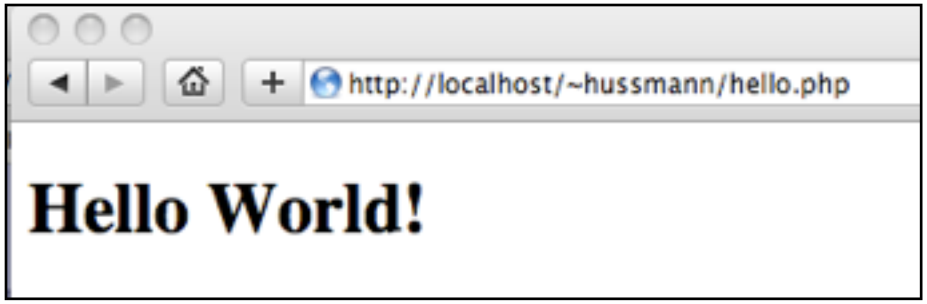
Prerequisites for Using PHP in Practice

- Always (even if using just one computer)
  - Installation of a Web server
    - OpenSource: *Apache*
    - Microsoft *Internet Information Server*
  - Invocation of PHP always indirectly by loading pages from server (http://...)
    - Loading from local computer: http://localhost/...
- Installation of PHP software as plug-in for used Web server
- Very often also installation of a data base system (e.g. MySQL)
- Frequently used acronyms for specific configurations:
  - LAMP: Linux, Apache, MySQL, PHP
  - WIMP: Windows, Internet Information Server, MySQL, PHP
  - MOXAMP: MacOS X, Apache, MySQL, PHP

Hello World in PHP

```
<!DOCTYPE html>

<html>
<head>
  <title>Hello World with PHP</title>
</head>

<body>
  <h1>
     <?php echo "Hello World!"; ?>
  </h1>
</body>
</html>
```

File hello.php
in Web server directory


http://localhost/~hussmann/hello.php

Hello World!

Embedding of PHP into HTML

- XML style (used here):
  - Like *Processing Instructions* in XML

```
<?php    PHP Text   ?>
```

- SGML style:
  - Widely used in older scripts
  - Not really recommendable: PHP language not specified

```
<?    PHP Text   ?>
```

- HTML style:
  - Using HTML tag:

```
<script language="php">   PHP Text  </script>
```

PHP Syntax (1)

- Inheritance from shell scripts
  - Variables start with "$"
  - Some UNIX commands part of the language, e.g.:

    ```
    echo "Hello";
    ```
- Control statements exist in different versions, e.g.:

```
if (bedingung1)
  anw1
elseif (bedingung2)
  anw2
else anw3;

if (bedingung1):          anwfolge1
elseif (bedingung2):      anwfolge2
else:                     anwfolge3
endif;
```

PHP Syntax (2)

- Various comment styles:
  - One-line comment, C style:

```
echo "Hello"; // Hello World
```

  - One-line comment, Perl style / Unix shell style:

```
echo "Hello"; # Hello World
```

  - "One line" ends also at end of PHP block
  - Multi-line comment, C-style:

```
echo "Hello"; /* Comment
  spreads over multiple lines */
```

  - Do not create nested C-style comments!

- Instruction must always be terminated with ";"
  - Exception: end of PHP block contains implicit ";"

PHP Type System

- Scalar types:
  - boolean, integer, float (aka double), string
- Compound types:
  - array, object
- Special types:
  - resource, NULL
  - Resource type: refers to external resource, like a file

- "The type of a variable is not usually set by the programmer; rather, it is decided at runtime by PHP depending on the context in which that variable is used."

  (PHP Reference Manual)