The Responsiveness problem (and solution: Ajax)

Reactive Web Design

Reactive Web Design: a set of techniques that can be used to build sites that always feel fast and responsive to user input regardless of the network speed or latency.

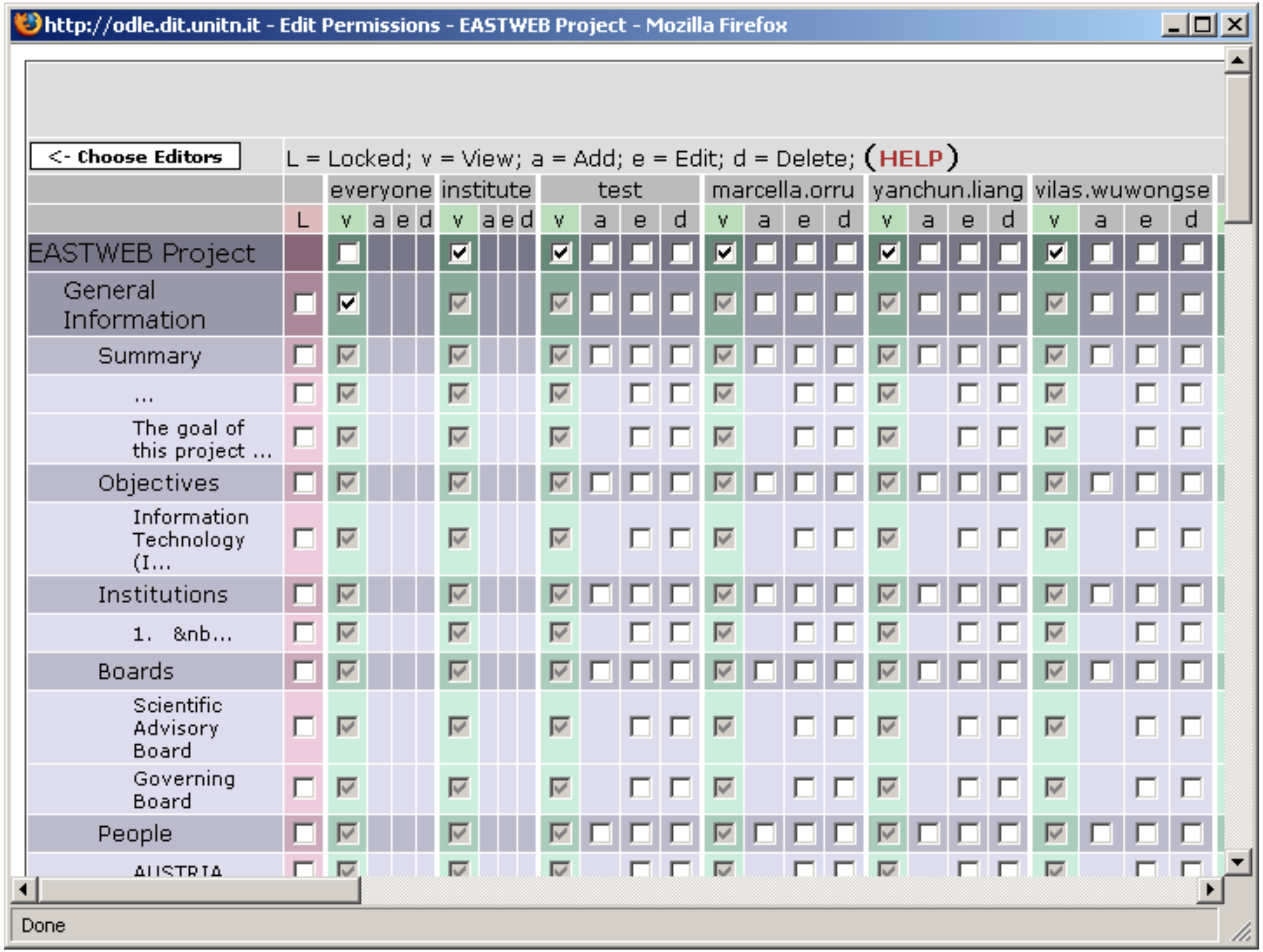
Reactive programming is programming with **asynchronous data streams**.

https://gist.github.com/staltz/868e7e9bc2a7b8c1f754

Responsive Web Design

Responsive design is an approach to **web** page creation that makes use of flexible layouts, flexible images and cascading style sheet media queries. The goal of **responsive design** is to build **web** pages that detect the visitor's screen size and orientation and change the layout accordingly.

The form nightmare…



http://odle.dit.unitn.it - Edit Permissions - EASTWEB Project - Mozilla Firefox

<- Choose Editors

L = Locked; v = View; a = Add; e = Edit; d = Delete; (HELP)

		everyone				institute				test				marcella.orru				yanchun.liang				vilas.wuwongse			
	L	v	a	e	d	v	a	e	d	v	a	e	d	v	a	e	d	v	a	e	d	v	a	e	d
EASTWEB Project		☐				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
General Information	☐	☑				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
Summary	☐	☑				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
…	☐	☑				☑				☑		☐	☐	☑		☐	☐	☑		☐	☐	☑		☐	☐
The goal of this project …	☐	☑				☑				☑		☐	☐	☑		☐	☐	☑		☐	☐	☑		☐	☐
Objectives	☐	☑				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
Information Technology (I…	☐	☑				☑				☑		☐	☐	☑		☐	☐	☑		☐	☐	☑		☐	☐
Institutions	☐	☑				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
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Boards	☐	☑				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
Scientific Advisory Board	☐	☑				☑				☑		☐	☐	☑		☐	☐	☑		☐	☐	☑		☐	☐
Governing Board	☐	☑				☑				☑		☐	☐	☑		☐	☐	☑		☐	☐	☑		☐	☐
People	☐	☑				☑				☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐
AUSTRIA	☐	☑				☑				☑		☐	☐	☑		☐	☐	☑		☐	☐	☑		☐	☐

Done

Ajax !

- not a technology in itself: it is a term coined in 2005 by Jesse James Garrett: “Asynchronous JavaScript + XML”.
- blur the line between web-based and desktop applications.
- rich, highly responsive and interactive interfaces

Ajax was born as:

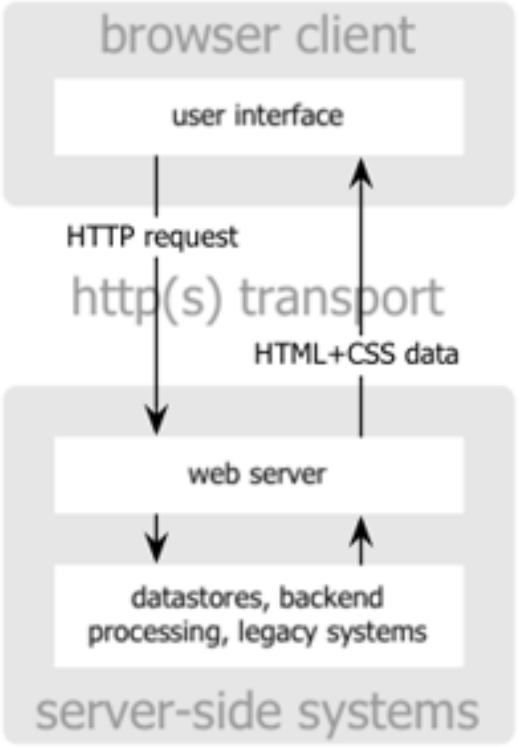
- dynamic presentation based on XHTML + CSS;
- dynamic display and interaction using Document Object Model;
- data exchange and manipulation using XML e XSLT;
- asynchrounous data fetching using XMLHttpRequest;
- JavaScript as glue.

How does Ajax work?

- The core idea behind AJAX is to make the communication with the server asynchronous, so that data is transferred and processed in the background.
- As a result the user can continue working on the other parts of the page without interruption.
- In an AJAX-enabled application only the relevant page elements are updated, only when this is necessary.

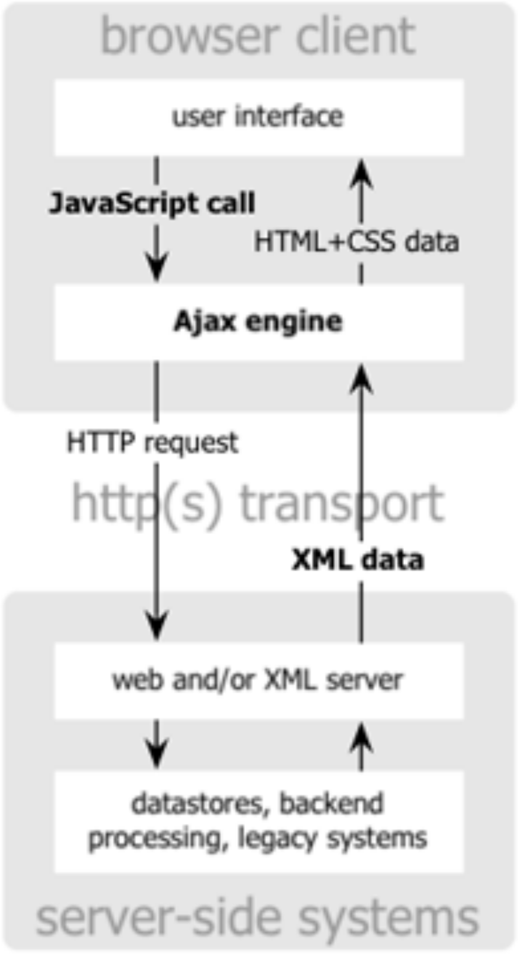
The paradigms

1.0



classic
web application model

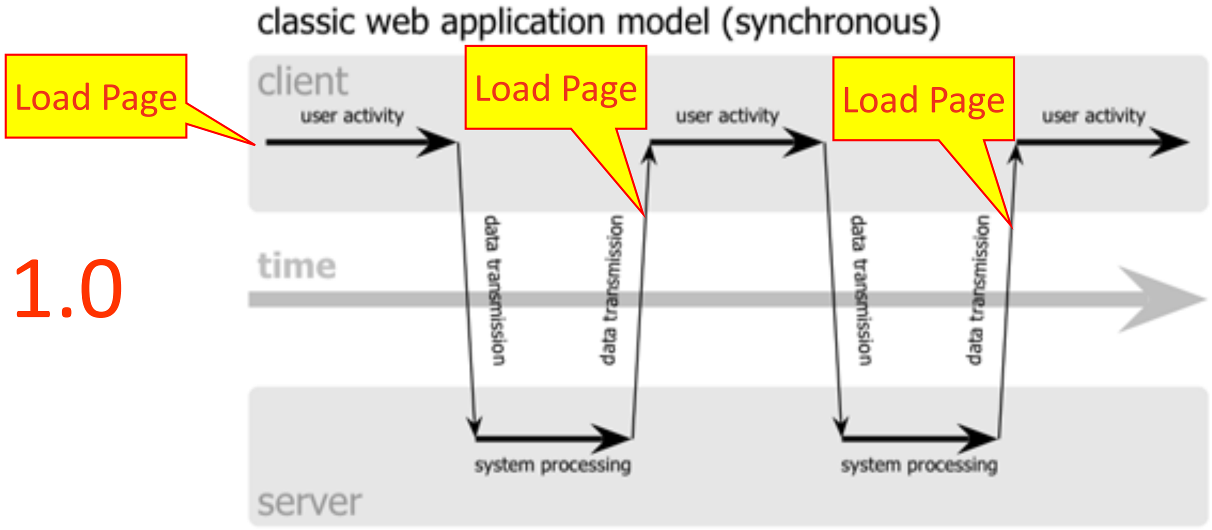
2.0

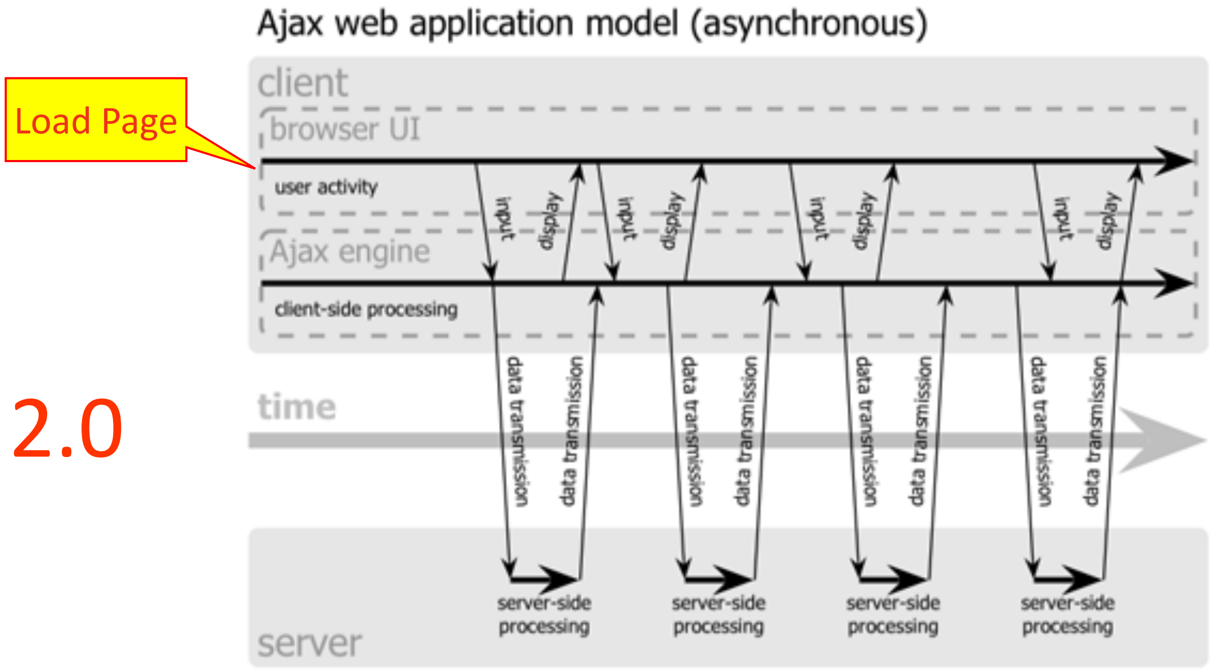


Ajax
web application model

Pictures after
Jesse James Garrett

The models





Pictures after

Jesse James Garrett

The heart and history of Ajax

- First used after Microsoft implemented Microsoft *XMLHTTP* COM object that was part of The Microsoft® XML Parser (IE 5.1)
- Similarly supported by a Mozilla Javascript object *XMLHttpRequest (Mozilla 1.0, Firefox, Safari 1.2 etc.)*
- Massively used by Google

Other labels for the same technology were Load on Demand, Asynchronous Requests, Callbacks, Out-of-band Calls, etc.

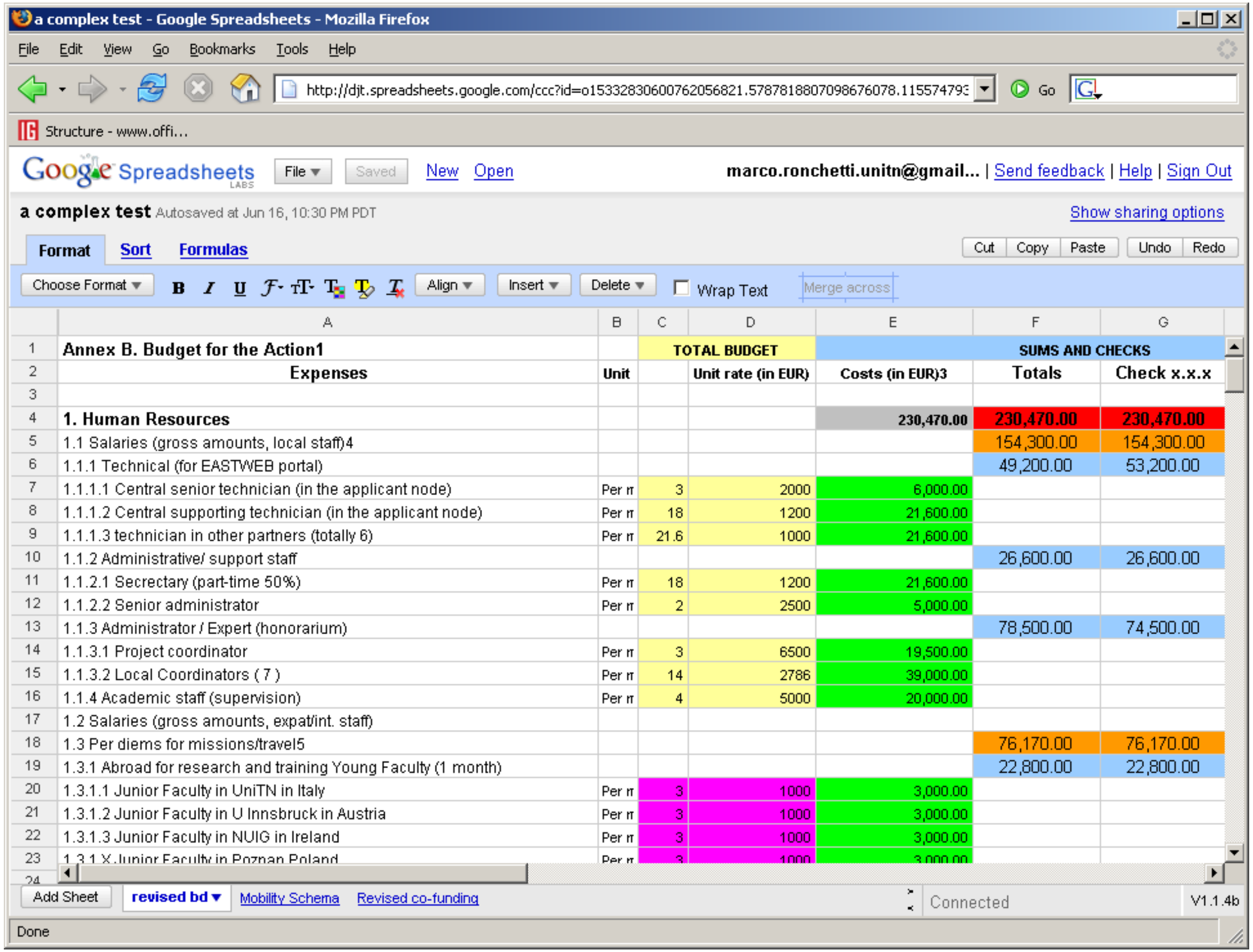
Ajax code

```
if (window.XMLHttpRequest) { // Mozilla, Safari, ...
    http_request = new XMLHttpRequest();
} else if (window.ActiveXObject) { // IE
    http_request = new ActiveXObject("Microsoft.XMLHTTP");
}
```

Ajax - advantages

- Rich applications in browsers
- No issues with installation
- Built on existing infrastructure (TCP/IP, SSL, HTTP, XML…)

The (impressive!) result



a complex test Autosaved at Jun 16, 10:30 PM PDT

	A	B	C	D	E	F	G
1	**Annex B. Budget for the Action1**		**TOTAL BUDGET**		**SUMS AND CHECKS**		
2	**Expenses**	**Unit**		**Unit rate (in EUR)**	**Costs (in EUR)3**	**Totals**	**Check x.x.x**
3							
4	**1. Human Resources**				**230,470.00**	230,470.00	230,470.00
5	1.1 Salaries (gross amounts, local staff)4					154,300.00	154,300.00
6	1.1.1 Technical (for EASTWEB portal)					49,200.00	53,200.00
7	1.1.1.1 Central senior technician (in the applicant node)	Per m	3	2000	6,000.00		
8	1.1.1.2 Central supporting technician (in the applicant node)	Per m	18	1200	21,600.00		
9	1.1.1.3 technician in other partners (totally 6)	Per m	21.6	1000	21,600.00		
10	1.1.2 Administrative/ support staff					26,600.00	26,600.00
11	1.1.2.1 Secrectary (part-time 50%)	Per m	18	1200	21,600.00		
12	1.1.2.2 Senior administrator	Per m	2	2500	5,000.00		
13	1.1.3 Administrator / Expert (honorarium)					78,500.00	74,500.00
14	1.1.3.1 Project coordinator	Per m	3	6500	19,500.00		
15	1.1.3.2 Local Coordinators (7)	Per m	14	2786	39,000.00		
16	1.1.4 Academic staff (supervision)	Per m	4	5000	20,000.00		
17	1.2 Salaries (gross amounts, expat/int. staff)						
18	1.3 Per diems for missions/travel5					76,170.00	76,170.00
19	1.3.1 Abroad for research and training Young Faculty (1 month)					22,800.00	22,800.00
20	1.3.1.1 Junior Faculty in UniTN in Italy	Per m	3	1000	3,000.00		
21	1.3.1.2 Junior Faculty in U Innsbruck in Austria	Per m	3	1000	3,000.00		
22	1.3.1.3 Junior Faculty in NUIG in Ireland	Per m	3	1000	3,000.00		
23	1.3.1.X Junior Faculty in Poznan Poland	Per m	3	1000	3,000.00		
24							

Ajax - advantages

- Better Performance and Efficiency
  - small amount of data transferred from the server. Beneficial for data-intensive applications as well as for low-bandwidth networks.
- More Responsive Interfaces
  - the improved performance give the feeling that updates are happening instantly. AJAX web applications appear to behave much like their desktop counterparts.
- Reduced or Eliminated "Waiting" Time
  - only the relevant page elements are updates, with the rest of the page remaining unchanged. This decreases the idle waiting time.
- Increased Usability
  - Users can work with the rest of the page while data is being transferred in the background.

XMLHttpRequest
Getting static resources

```
function loadDoc() {
  var xhttp = new XMLHttpRequest();
  xhttp.onreadystatechange = function() {
    if (this.readyState == 4 && this.status == 200) {
     document.getElementById("demo").innerHTML =

            this.responseText;
    }
  };
  xhttp.open("GET", "ajax_info.txt", true);
  xhttp.send();
}
```

Asynchronous Programming!

Getting dynamic resources with GET

```
function loadDoc() {
  var xhttp = new XMLHttpRequest();
  xhttp.onreadystatechange = function() {
    if (this.readyState == 4 && this.status == 200) {
     document.getElementById("demo").innerHTML =

            this.responseText;
    }
  };
  xhttp.open("GET", "myservlet?param1=27", true);
  xhttp.send();
}
```

Note: if you want to avoid getting cached results, add a fake parameter
with the current time, e.g.

```
xhttp.open("GET", url + ((/\?/).test(url) ? "&" : "?") + (new Date()).getTime());
```

See https://www.w3schools.com/jsref/jsref_regexp_test.asp to understand the code above

Getting dynamic resources with POST

```
function loadDoc() {
  var xhttp = new XMLHttpRequest();
  xhttp.onreadystatechange = function() {
    if (this.readyState == 4 && this.status == 200) {
     document.getElementById("demo").innerHTML =
            this.responseText;
    }
  };
  xhttp.open("POST", "ajax_info.txt", true);
  xhttp.setRequestHeader("Content-type",
      "application/x-www-form-urlencoded");
  xhttp.send("nome=Dorothea&lname=Wierer");
}
```

1) add an HTTP header with setRequestHeader().
2) Specify the data you want to send in the send() method

XMLHttpRequest methods

new XMLHttpRequest()	Creates a new XMLHttpRequest object
abort()	Cancels the current request
getAllResponseHeaders()	Returns header information
getResponseHeader()	Returns specific header information
open(*method, url, async, user, psw*)	Specifies the request *method*: the request type **GET** or **POST** *url*: the file location *async*: true (asynchronous) or false (synchronous) *user*: optional user name *psw*: optional password
send()	Sends the request to the server Used for GET requests
send(*string*)	Sends the request to the server. Used for POST requests
setRequestHeader()	Adds a label/value pair to the header to be sent

XMLHttpRequest properties

Property	Description
onreadystatechange	Defines a function to be called when the readyState property changes
readyState	Holds the status of the XMLHttpRequest. 0: request not initialized 1: server connection established 2: request received 3: processing request 4: request finished and response is ready
responseText	Returns the response data as a string
responseXML	Returns the response data as XML data
status	Returns the HTTP status-number of a request, e.g. 200: "OK" 403: "Forbidden" 404: "Not Found"
statusText	Returns the status-text (e.g. "OK" or "Not Found")

Challenges: make sure that you…

- Preserve the Normal Page Lifecycle – as much as possible!
- Reflect Control State on the Server – in real-life scenarios there is no use of simply rendering controls on the page.
- Support Cross-Browser usage – there are different implementation of the XmlHttpRequest object. You should make sure that all AJAX components you choose operate properly on various browsers and platforms.
- Ensure proper Operation when Cookies are Disabled – support cookieless sessions.

Challenges: make sure that you…

- Give visual feedback - When a user clicks on something in the AJAX user interface, they need immediate visual feedback
- Keep the Back button – make sure that the Back button in your application functions on every page of the site.
- Use links for navigation – avoid the temptation to use links as an interface on your AJAX application to change the state of your application. Users have been trained over many years to expect a link to “take” them somewhere, so give them what they expect.
- Use human-readable links – people like to pass the addresses of useful web pages to each other. Make sure your application supports URLs that people can share easily, so not too long or complex.

Adapted from: www.telerik.com/documents/Telerik_and_AJAX.pdf

Challenges: make sure that you…

- Don’t bloat the code – make sure that your application uses as little client-side scripting as possible. This reduces download time for the page and also reduces the processor requirements on the client browser, so results in a faster browser experience.
- Follow UI conventions – AJAX is a world of possibilities, but when it comes to user interface the best is invariably the familiar. If you’re creating a user interface for a specific feature, the place to start is by replicating an existing successful interface and looking at what your clients expect. Also remember that although it may be cool to implement drag-and-drop, few people may realize the interface relies on it.
- Don’t scroll – users like to feel in control, so if they have moved the scrollbar to a specific place, don’t move the page somewhere else.
- Reduce page loads – do as much as you can to reduce the number of page loads the user has to do to achieve their goal.

Adapted from: www.telerik.com/documents/Telerik_and_AJAX.pdf

AJAX Tutorial and reference

https://www.w3schools.com/js/js_ajax_intro.asp

https://developer.mozilla.org/en-US/docs/Web/Guide/AJAX

https://www.tutorialspoint.com/ajax/ajax_technology.htm

CORS - Cross-Origin Resource Sharing

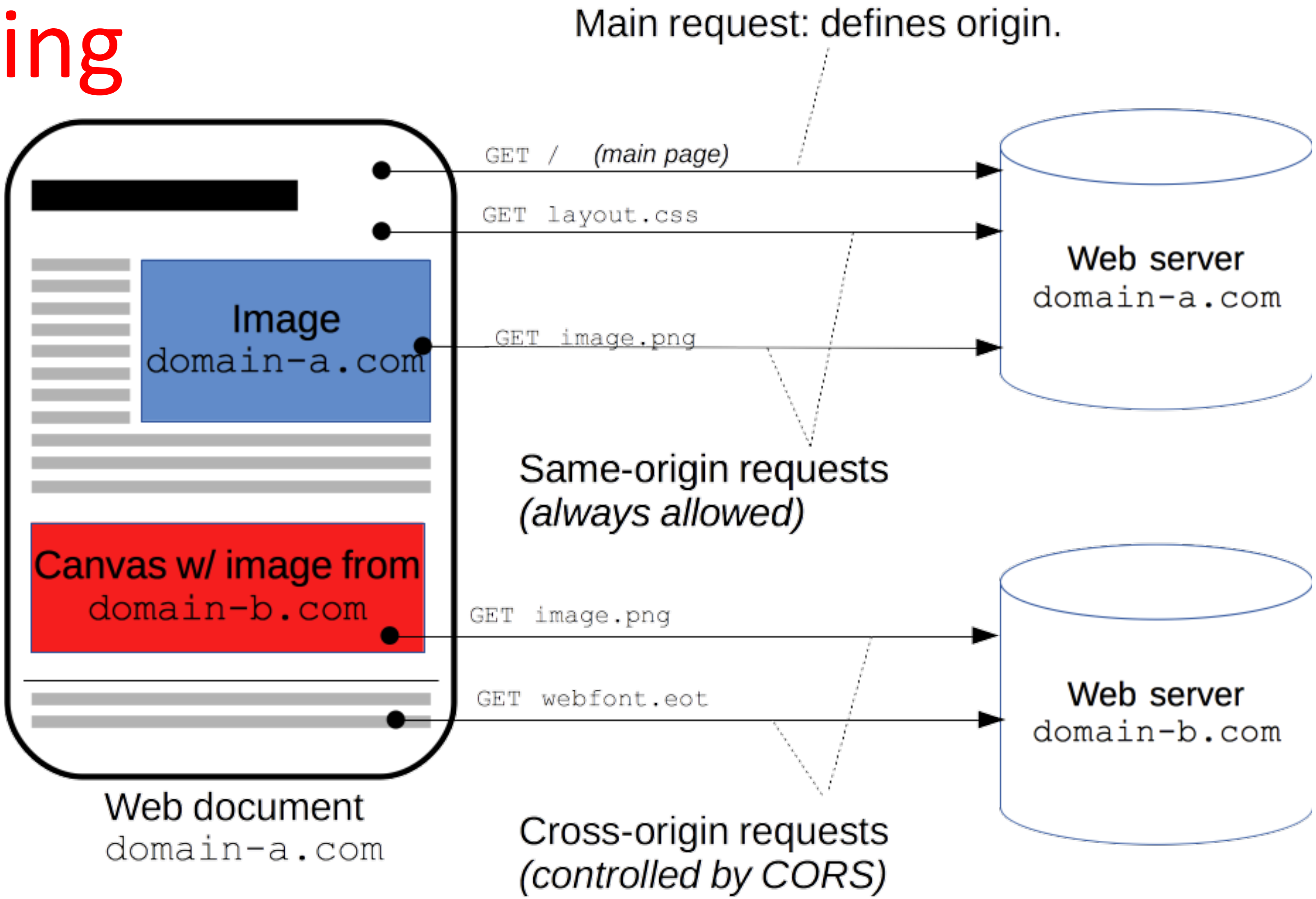


immagine da https://developer.mozilla.org/en-US/docs/Web/HTTP/CORS

CORS

- **Cross-site XMLHttpRequest**
- Modern browsers support cross-site requests by implementing the Cross-Origin Resource Sharing (CORS) standard. As long as the server is configured to allow requests from your web application's origin, XMLHttpRequest will work. Otherwise, an INVALID_ACCESS_ERR exception is thrown.
- CORS failures result in errors, but for security reasons, specifics about the error *are not available to JavaScript*. All the code knows is that an error occurred.

CORS

```
const xhr = new XMLHttpRequest();
const url = 'https://bar.other/resources/public-data/';
xhr.open('GET', url);
xhr.onreadystatechange = someHandler;
xhr.send();
```

What the browser will send to the server:

```
GET /resources/public-data/ HTTP/1.1
Host: bar.other
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS
X 10.14; rv:71.0) Gecko/20100101 Firefox/71.0
Accept: text/html,application/xhtml+xml,
application/xml;
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Connection: keep-alive
Origin: https://foo.example
```

How the server will respond:

CORS

```
HTTP/1.1 200 OK
Date: Mon, 01 Dec 2008 00:23:53 GMT
Server: Apache/2
Access-Control-Allow-Origin: *
Keep-Alive: timeout=2, max=100
Connection: Keep-Alive
Transfer-Encoding: chunked
Content-Type: application/xml

[…XML Data…]
```

Alternatives:

```
Access-Control-Allow-Origin: https://foo.example
```

For more detail, see https://developer.mozilla.org/en-US/docs/Web/HTTP/CORS

Adding CORS to Apache

- To add the CORS authorization to the header using Apache, simply add the following line inside either
  the <Directory>, <Location>, <Files> or <VirtualHost> sections of your server config (usually located in a *.conf file, such as httpd.conf or apache.conf), or within a .htaccess file:

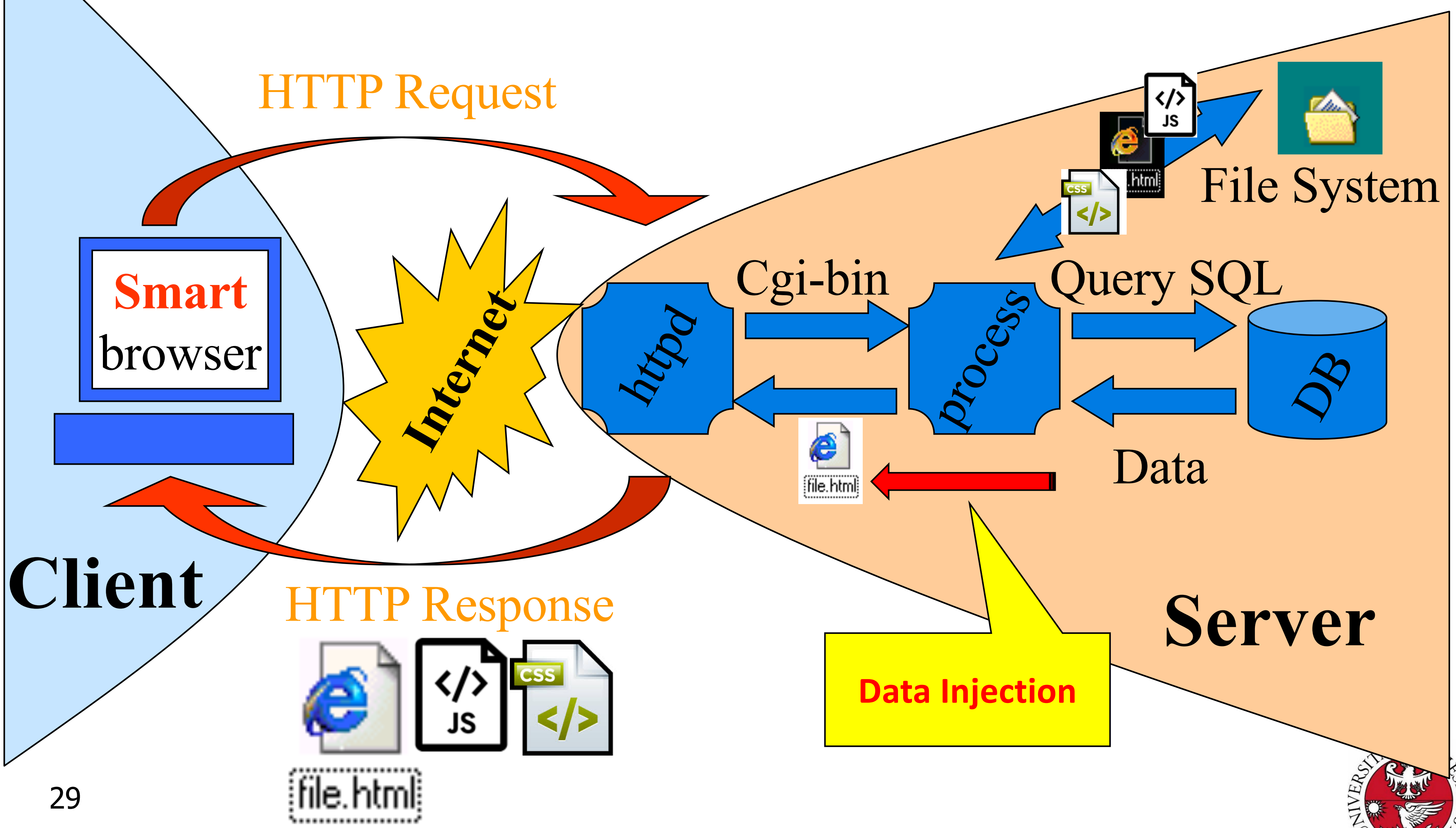
```
Header set Access-Control-Allow-Origin "*"
```

- https://enable-cors.org/server_apache.html

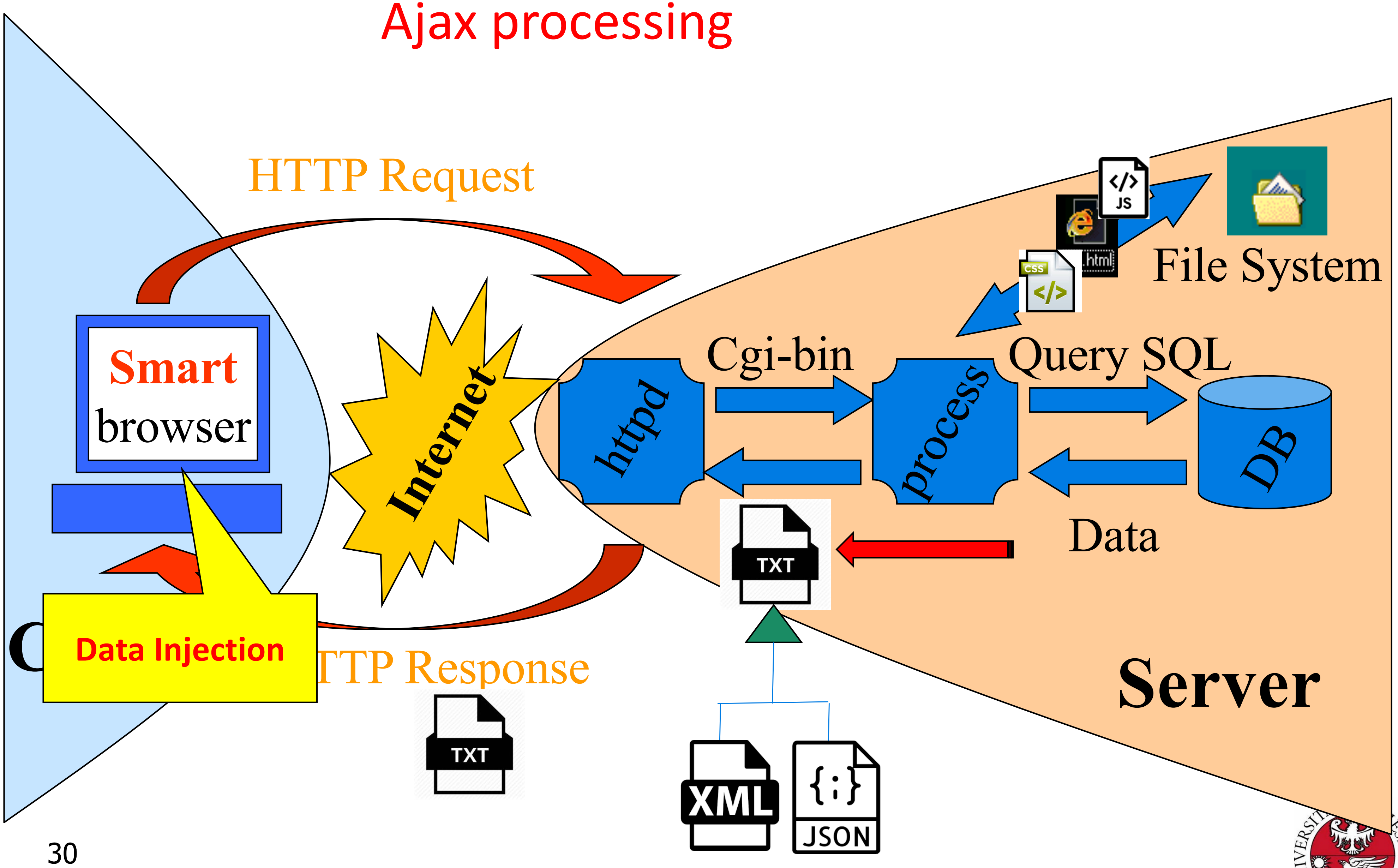
- https://poanchen.github.io/blog/2016/11/20/how-to-enable-cross-origin-resource-sharing-on-an-apache-server

Data transfer: Json

Traditional, server side page creation



Ajax processing



Two main forms of data trasfer

XML

```
<employees>
 <employee>
  <firstName>John</firstName>
  <lastName>Doe</lastName>
 </employee>
 <employee>
  <firstName>Anna</firstName>
  <lastName>Smith</lastName>
 </employee>
 <employee>
  <firstName>Peter</firstName>
  <lastName>Jones</lastName>
 </employee>
</employees>
```

JSON

```
{"employees":[
  { "firstName":"John",
    "lastName":"Doe" },
  { "firstName":"Anna",
    "lastName":"Smith" },
  { "firstName":"Peter",
    "lastName":"Jones" }
]}
```

XML vs JSON

Both JSON and XML:

- are "self describing" (human readable)
- are hierarchical (values within values)
- can be parsed and used by lots of programming languages
- can be fetched with an XMLHttpRequest

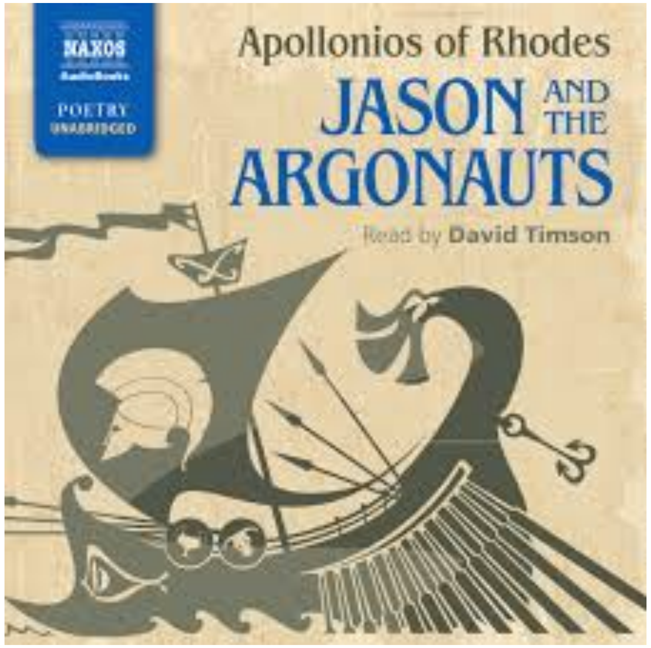
For AJAX applications, JSON is faster and easier than XML:

XML	**JSON**
Fetch an XML document	Fetch a JSON string
Use the XML DOM to loop through the document	JSON.Parse the JSON string
Extract values and store in variables	

JSON – JavaScript Object Notation

JSON is a language-independent data format.

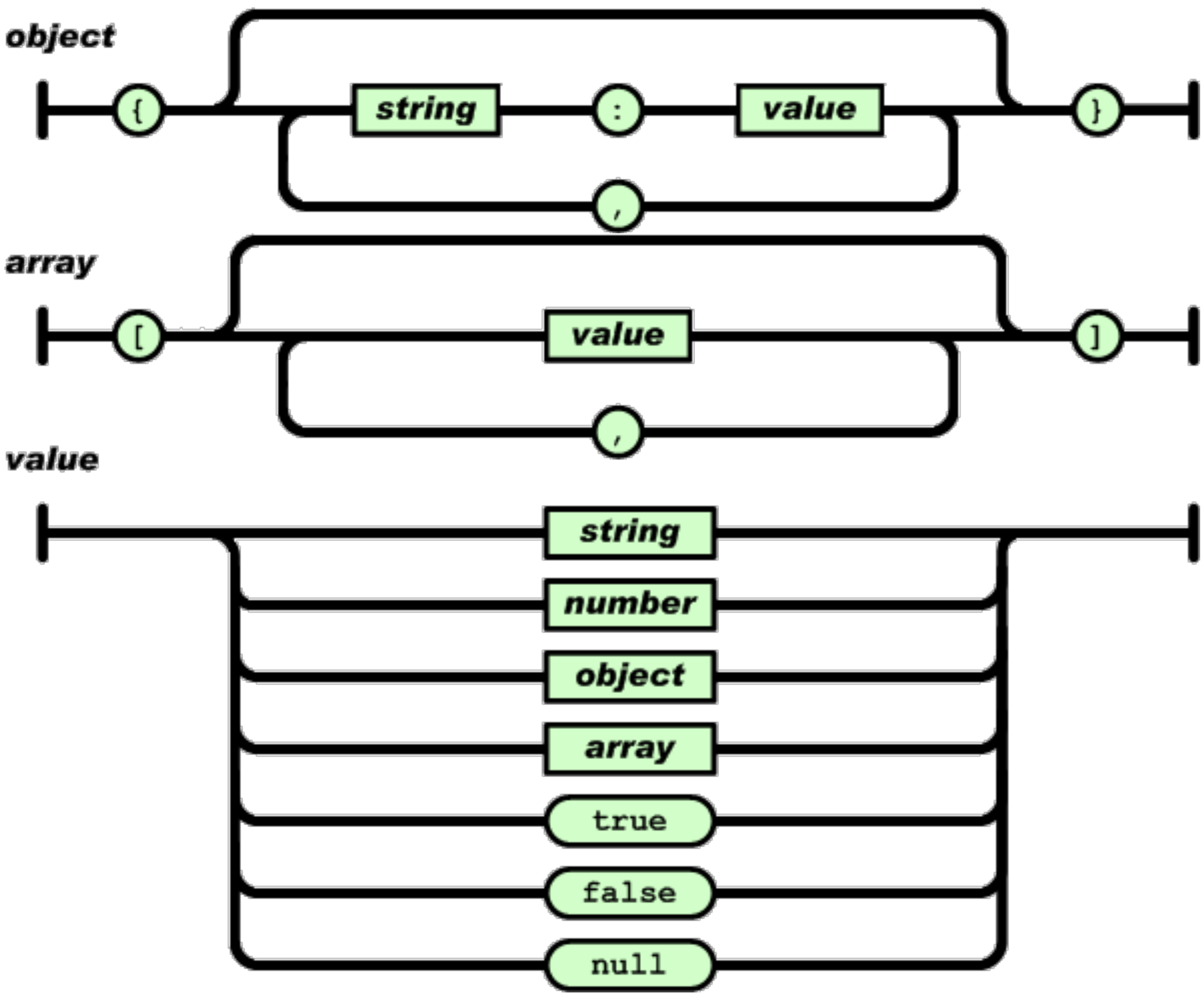
```
{ "name": "Mario",
        "surname": "Rossi",
        "active": true,
        "favoriteNumber": 42,
        "birthday": {
                "day": 1,
                "month": 1,
                "year": 2000
        },
        "languages": [ "it", "en" ]
}
```



Datatypes:

- int, float
- Boolean
- String
- Arrays []
- Associative Arrays {}
- null

JSON


object
{
string
:
value
,
}
array
[
value
,
]
value
string
number
object
array
true
false
null

Parsing JSON in JavaScript

```
var text = '{ "name":"John", "birth":"1986-12-14", "city":"New York"}';
var obj = JSON.parse(text);
obj.birth = new Date(obj.birth);

document.getElementById("demo").innerHTML = obj.name + ", " + obj.birth;
```

Argo (Parsing JSON in Java)

```
{
  "name": "Black Lace",
  "sales": 110921,
  "totalRoyalties": 10223.82,
  "singles": [
    "Superman", "Agadoo"
  ]
}
```

```
String secondSingle = new JdomParser().parse(jsonText)
   .getStringValue("singles", 1);
```

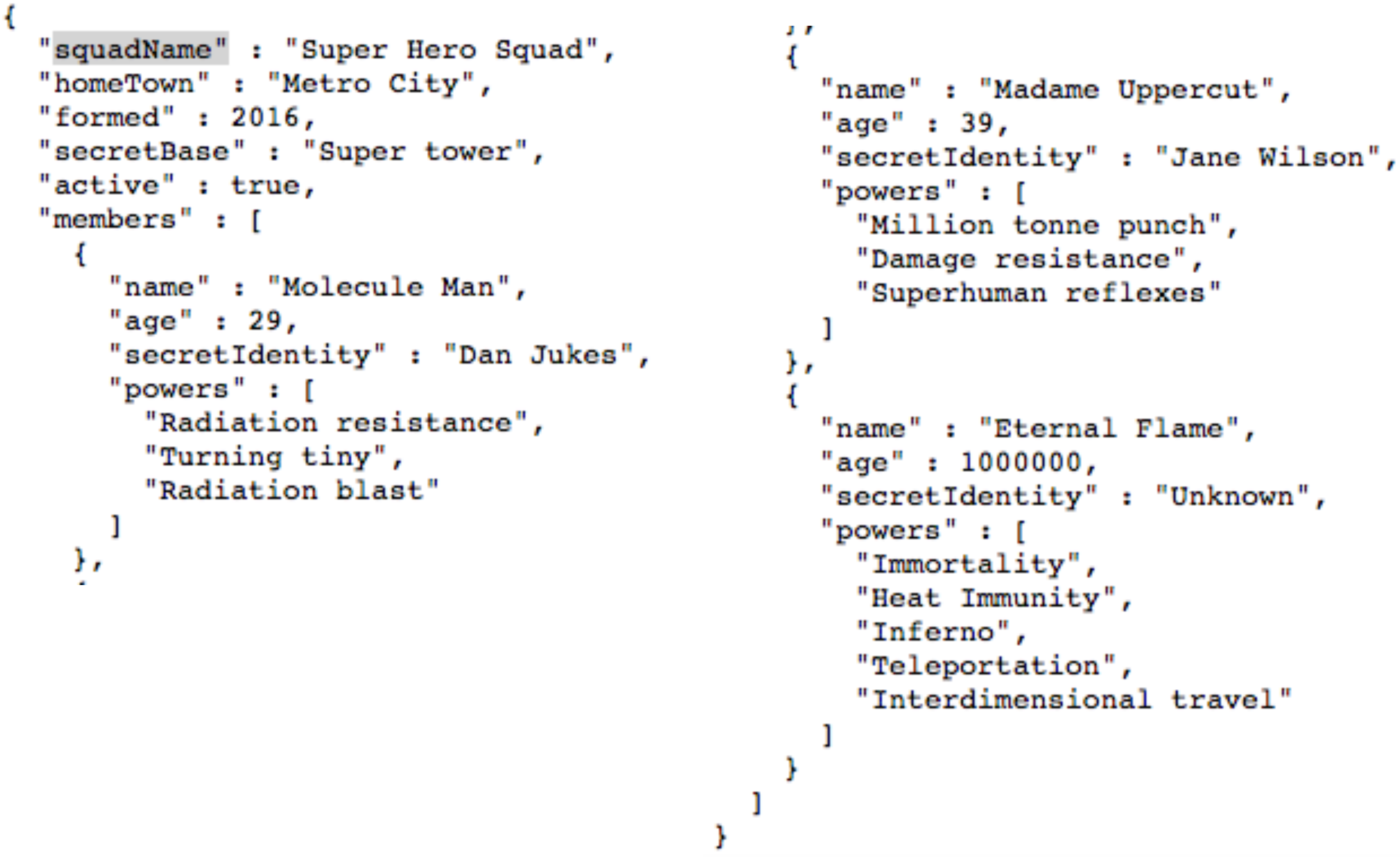
http://argo.sourceforge.net/index.html

AJAJ

```
var my_JSON_object;
var url=" https://mdn.github.io/learning-
area/javascript/oojs/json/superheroes.json"
var xhttp = new XMLHttpRequest();
xhttp.open("GET", url, true);
xhttp.responseType = "json";
xhttp.onreadystatechange = function () {
  var done = 4, ok = 200;
  if (this.readyState === done && this.status === ok)
  {
    my_JSON_object = this.response;
  }
};
xhttp.send();}
```

An example

https://mdn.github.io/learning-area/javascript/oojs/json/superheroes.json



```
{
  "squadName" : "Super Hero Squad",
  "homeTown" : "Metro City",
  "formed" : 2016,
  "secretBase" : "Super tower",
  "active" : true,
  "members" : [
    {
      "name" : "Molecule Man",
      "age" : 29,
      "secretIdentity" : "Dan Jukes",
      "powers" : [
        "Radiation resistance",
        "Turning tiny",
        "Radiation blast"
      ]
    },
    {
      "name" : "Madame Uppercut",
      "age" : 39,
      "secretIdentity" : "Jane Wilson",
      "powers" : [
        "Million tonne punch",
        "Damage resistance",
        "Superhuman reflexes"
      ]
    },
    {
      "name" : "Eternal Flame",
      "age" : 1000000,
      "secretIdentity" : "Unknown",
      "powers" : [
        "Immortality",
        "Heat Immunity",
        "Inferno",
        "Teleportation",
        "Interdimensional travel"
      ]
    }
  ]
}
```

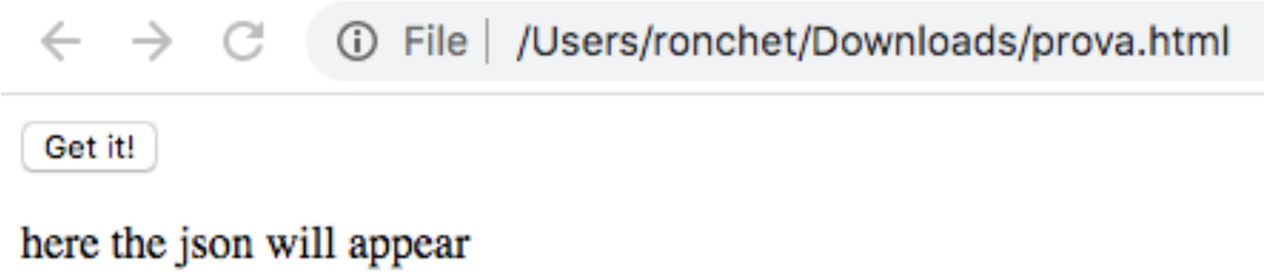
The traps of asynchronous computing 1A

```
<script>
  function getJson() {
    var my_JSON_object;
    var url="https://mdn.github.io/learning-
       area/javascript/oojs/json/superheroes.json"
    var xhttp = new XMLHttpRequest();
    xhttp.open("GET", url, true);
    xhttp.responseType = "json";
    xhttp.onreadystatechange = function () {
       var done = 4, ok = 200;
       if (this.readyState === done && this.status === ok){
          my_JSON_object = this.response;
       }
    };
    xhttp.send();
    return my_JSON_object;
  }
</script>
```

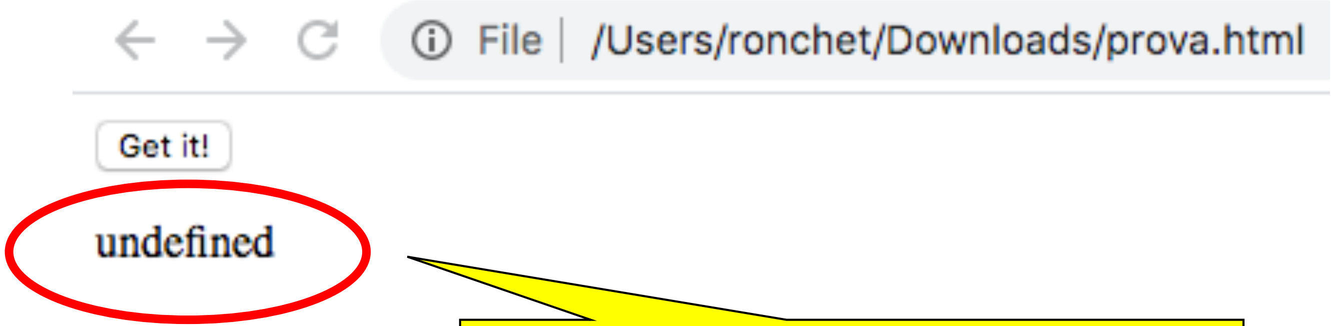
The traps of asynchronous computing 1B

```
<!DOCTYPE html>
<head>
    <title>AJAJ Demo</title>
    <script>…</script>
</head>
  <body>
    <form>
     <input type="BUTTON" onClick=
       'document.getElementById("myPar").innerHTML=getJson();'>
    </form>
    <p id="myPar">here the json will appear</p>
  </body>
</html>
```

The traps of asynchronous computing 1 out



here the json will appear



undefined

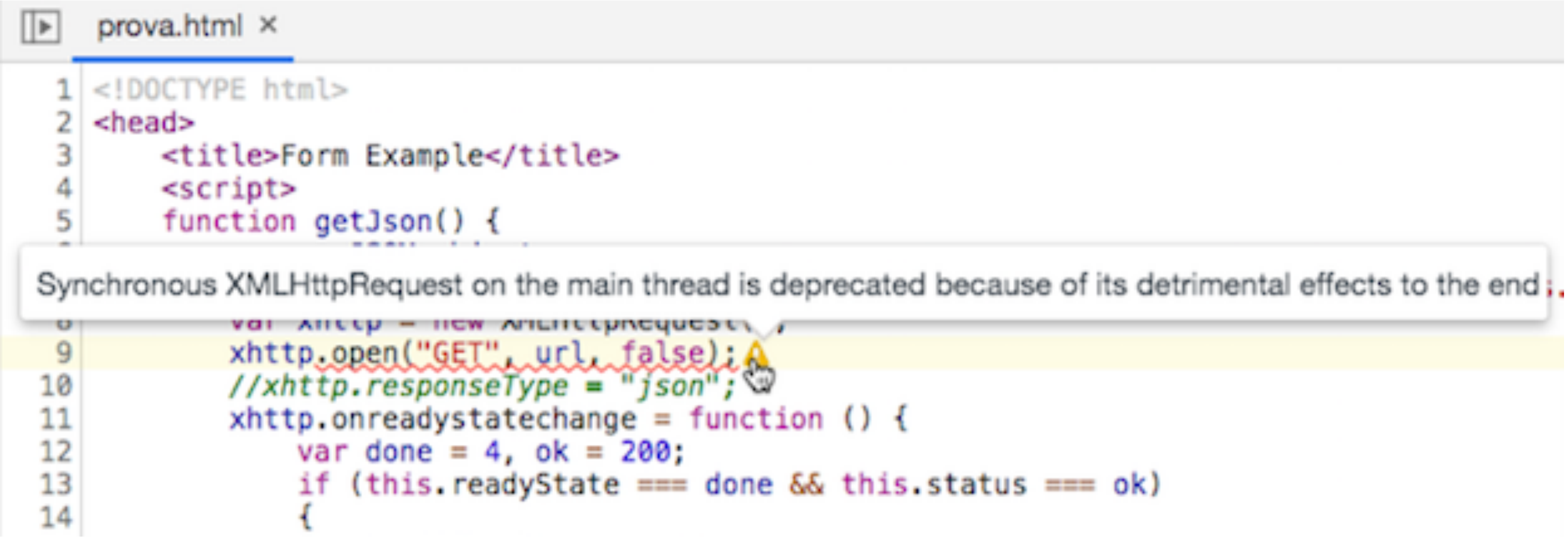
Because the call is async!

The traps of asynchronous computing 2A

```
<script>
  function getJson() {
    var my_JSON_object;
    var url="https://mdn.github.io/learning-
       area/javascript/oojs/json/superheroes.json"
    var xhttp = new XMLHttpRequest();
    xhttp.open("GET", url, false);
    xhttp.responseType = "json";
    xhttp.onreadystatechange = function () {
       var done = 4, ok = 200;
       if (this.readyState === done && this.status === ok){
          my_JSON_object = this.response;
       }
    };
    xhttp.send();
    return my_JSON_object;
  }
</script>
```

Let us make it sync

The traps of asynchronous computing 2 out a

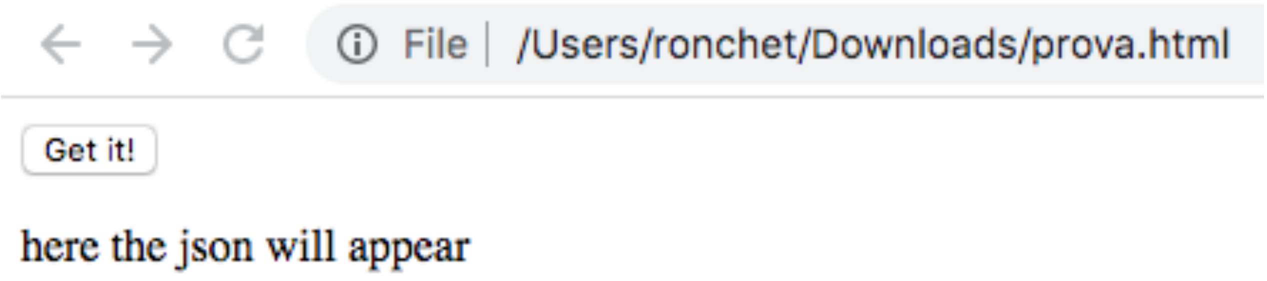


```
<!DOCTYPE html>
<head>
    <title>Form Example</title>
    <script>
    function getJson() {
```

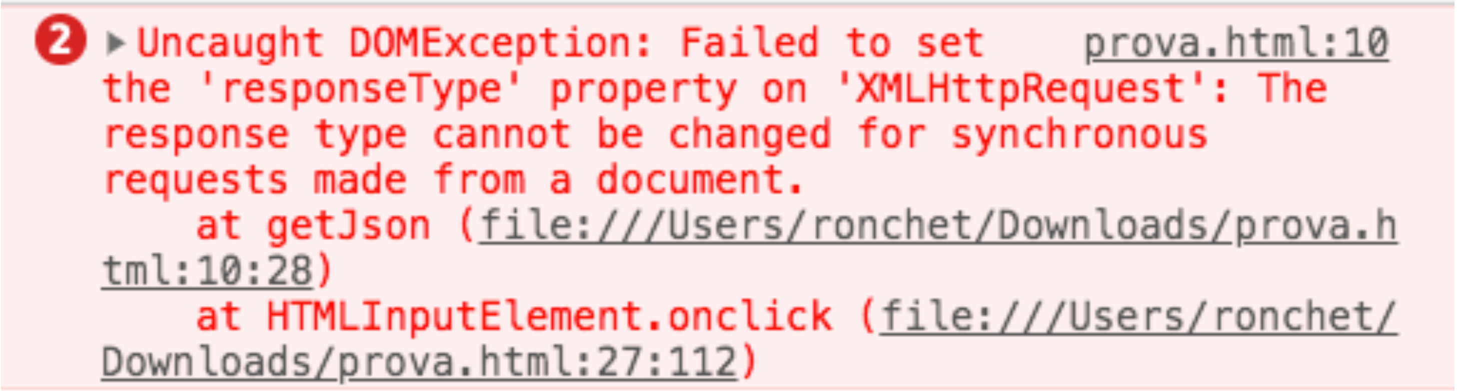
Synchronous XMLHttpRequest on the main thread is deprecated because of its detrimental effects to the end

```
        var xhttp = new XMLHttpRequest();
        xhttp.open("GET", url, false);
        //xhttp.responseType = "json";
        xhttp.onreadystatechange = function () {
            var done = 4, ok = 200;
            if (this.readyState === done && this.status === ok)
            {
```

The traps of asynchronous computing 2 out b



here the json will appear



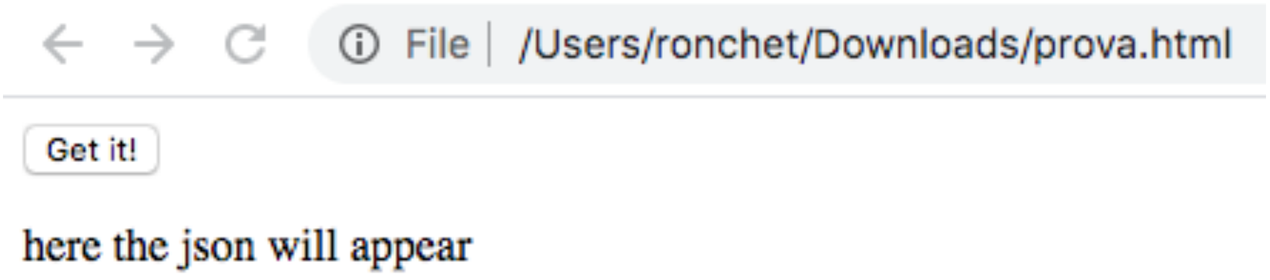
```
2 ▶Uncaught DOMException: Failed to set     prova.html:10
the 'responseType' property on 'XMLHttpRequest': The
response type cannot be changed for synchronous
requests made from a document.
    at getJson (file:///Users/ronchet/Downloads/prova.h
tml:10:28)
    at HTMLInputElement.onclick (file:///Users/ronchet/
Downloads/prova.html:27:112)
```

The traps of asynchronous computing 3A

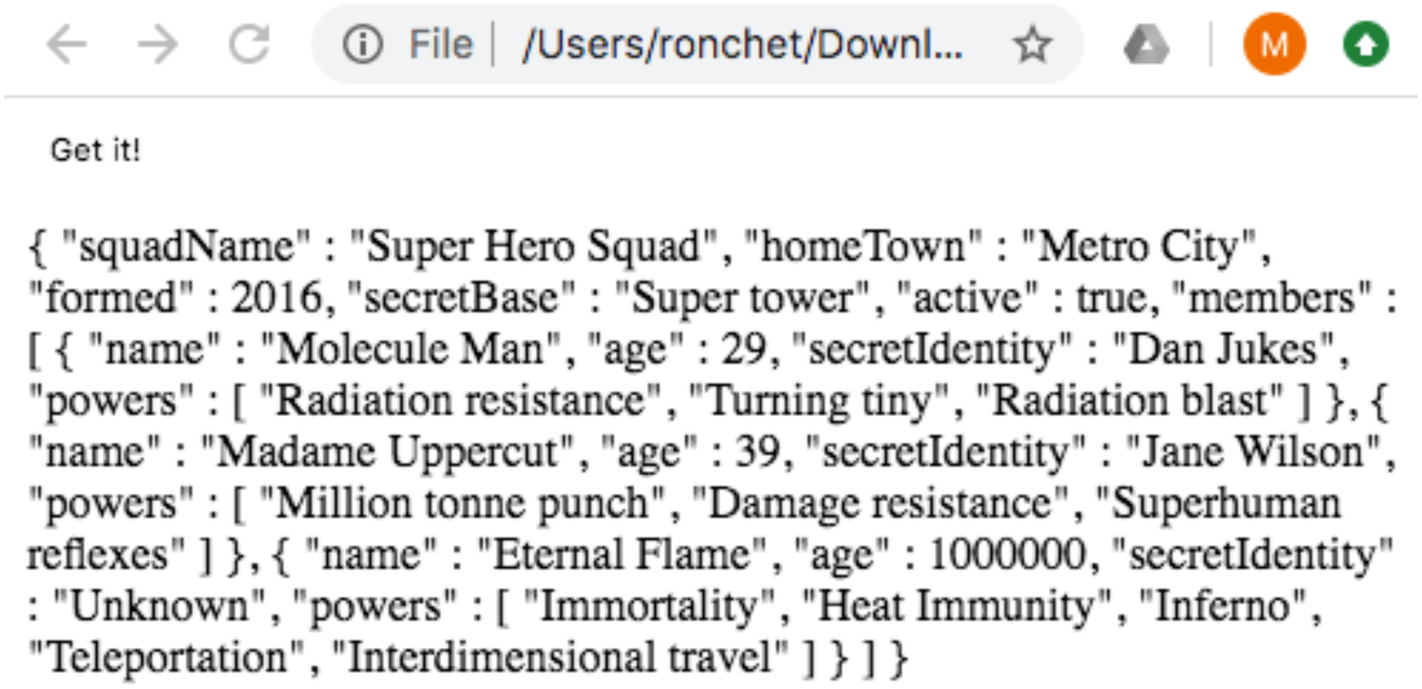
```
<script>
  function getJson() {
    var my_JSON_object;
    var url="https://mdn.github.io/learning-
       area/javascript/oojs/json/superheroes.json"
    var xhttp = new XMLHttpRequest();
    xhttp.open("GET", url, false);
    //xhttp.responseType = "json";
    xhttp.onreadystatechange = function () {
       var done = 4, ok = 200;
       if (this.readyState === done && this.status === ok){
          my_JSON_object = this.response;
       }
    };
    xhttp.send();
    return my_JSON_object;
  }
</script>
```

Let's comment this line

The traps of asynchronous computing 3 out



here the json will appear



```
{ "squadName" : "Super Hero Squad", "homeTown" : "Metro City",
"formed" : 2016, "secretBase" : "Super tower", "active" : true, "members" :
[ { "name" : "Molecule Man", "age" : 29, "secretIdentity" : "Dan Jukes",
"powers" : [ "Radiation resistance", "Turning tiny", "Radiation blast" ] }, {
"name" : "Madame Uppercut", "age" : 39, "secretIdentity" : "Jane Wilson",
"powers" : [ "Million tonne punch", "Damage resistance", "Superhuman
reflexes" ] }, { "name" : "Eternal Flame", "age" : 1000000, "secretIdentity"
: "Unknown", "powers" : [ "Immortality", "Heat Immunity", "Inferno",
"Teleportation", "Interdimensional travel" ] } ] }
```

The traps of asynchronous computing 4A

```
<script>
  function getJson() {
    var my_JSON_object;
    var url="https://mdn.github.io/learning-
       area/javascript/oojs/json/superheroes.json"
    var xhttp = new XMLHttpRequest();
    xhttp.open("GET", url, true);
    xhttp.responseType = "json";
    xhttp.onreadystatechange = function () {
       var done = 4, ok = 200;
       if (this.readyState === done && this.status === ok){
          my_JSON_object = this.response;
          document.getElementById("myPar".innerHTML=
              my_JSON_object.squadName;
       }
    };
    xhttp.send();
    // return my_JSON_object;
  }
</script>
```

Let's make it async again

This is the right way of doing things!

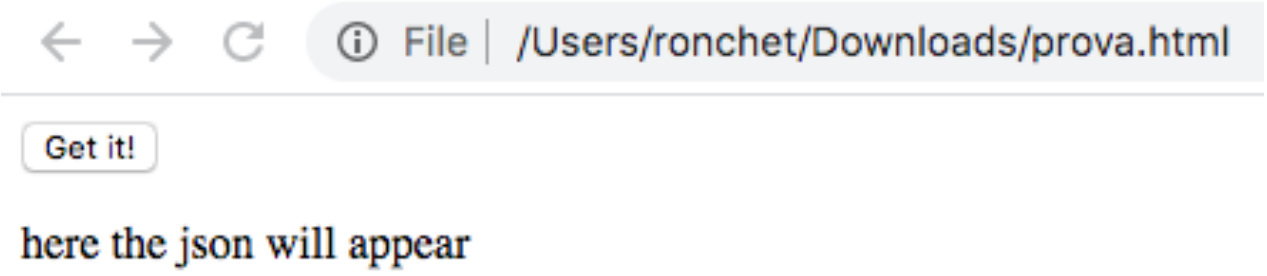
Let's comment this line

The traps of asynchronous computing 4B

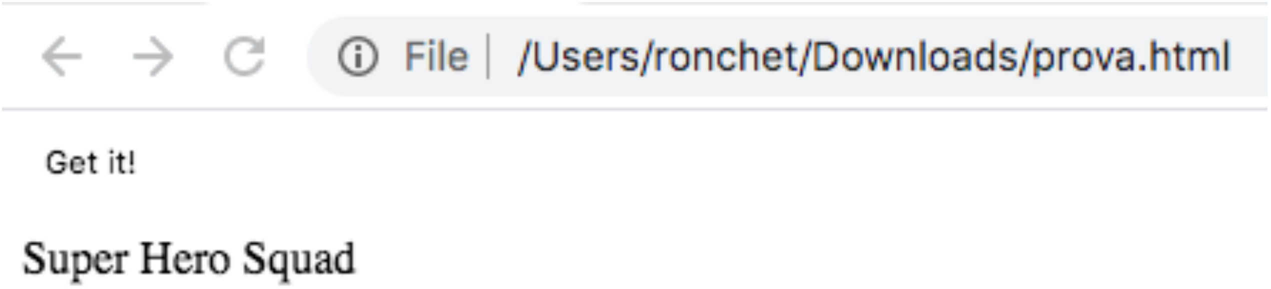
```
<!DOCTYPE html>
<head>
    <title>AJAJ Demo</title>
    <script>…</script>
</head>
  <body>
    <form>
     <input type="BUTTON" onClick=
       'getJson();'>
    </form>
    <p id="myPar">here the json will appear</p>
  </body>
</html>
```

This is the right way of doing things!

The traps of asynchronous computing 4 out



here the json will appear



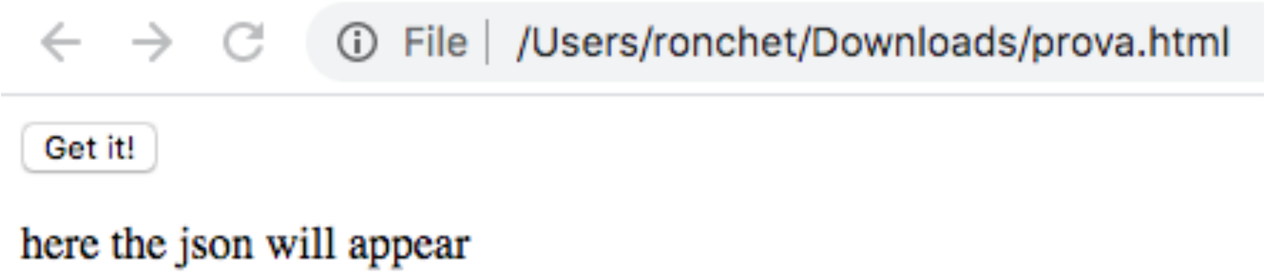
Super Hero Squad

The traps of asynchronous computing 5A

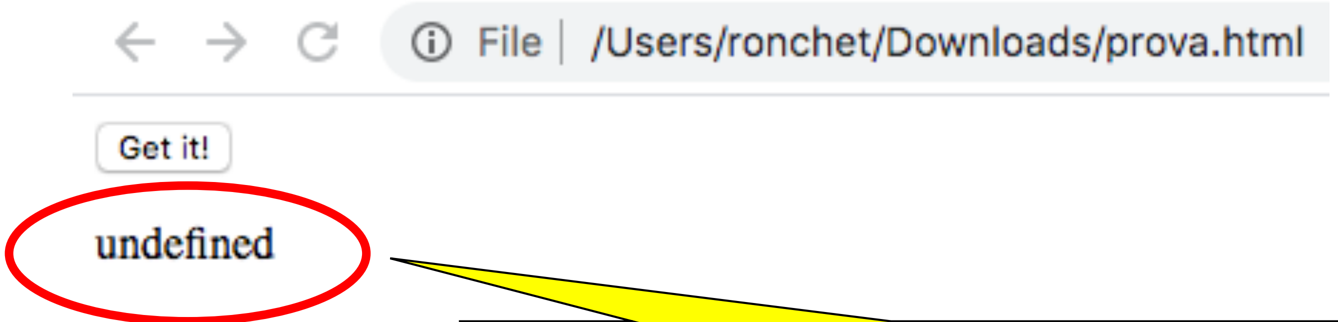
```
<script>
  function getJson() {
    var my_JSON_object;
    var url="https://mdn.github.io/learning-
       area/javascript/oojs/json/superheroes.json"
    var xhttp = new XMLHttpRequest();
    xhttp.open("GET", url, true);
    //xhttp.responseType = "json";
    xhttp.onreadystatechange = function () {
       var done = 4, ok = 200;
       if (this.readyState === done && this.status === ok){
          my_JSON_object = this.response;
          document.getElementById("myPar".innerHTML=
              my_JSON_object.squadName;

       }
    };
    xhttp.send();
    return my_JSON_object;
  }
</script>
```

Let's comment this line

The traps of asynchronous computing 5 out



here the json will appear



undefined

Because my_JSON_Object is now a String!

The JavaScript JSON object

The **JSON** object contains methods for parsing JSON text, and converting values to JSON. It can't be called or constructed, has two method properties:

- JSON.parse(*text*[, *reviver*]) Parse the string *text* as JSON, optionally transform the produced value and its properties, and return the value. Any violations of the JSON syntax, including those pertaining to the differences between JavaScript and JSON, cause a SyntaxError to be thrown. The *reviver* option allows for interpreting what the *replacer* has used to stand in for other datatypes.

- JSON.stringify(*value*[, *replacer*[, *space*]]) Return a JSON string corresponding to the specified value, optionally including only certain properties or replacing property values in a user-defined manner. By default, all instances of undefined are replaced with null, and other unsupported native data types are censored.
The *replacer* option allows for specifying other behavior.

JSON.parse

JSON string => JS data

```
const json = '{"result":true, "count":42}';
const obj = JSON.parse(json);

console.log(obj.count);    // expected output: 42

console.log(obj.result);  // expected output: true
```

JSON.parse with reviver function

JSON string => JS data

```
var text = '{ "name":"Dorothea Wierer",
              "birthDate":"1990-04-03",
              "city":"Brunico"}';

var obj = JSON.parse(text, function (key, value) {
  if (key == "birthDate") {
    return new Date(value);
  } else {
    return value;
  }
});
```

reviver function

JSON.stringify

JS data => JSON string

JS_Object

JS_Array

```
console.log(JSON.stringify({ x: 5, y: 6 }));
// expected output: "{"x":5,"y":6}"

console.log(JSON.stringify([new Number(3), new String('false'),
new Boolean(false)]));
// expected output: "[3,"false",false]"
```

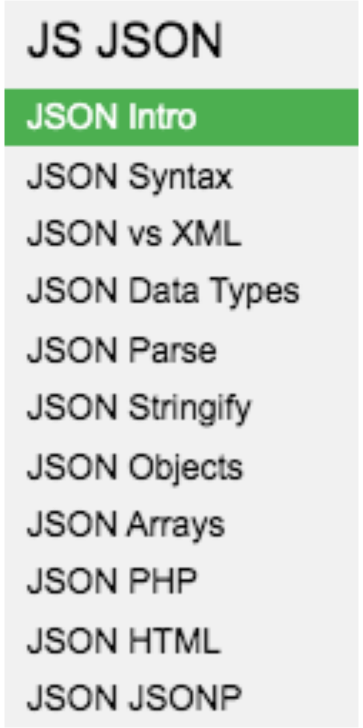
JS_special types

```
console.log(JSON.stringify({ x: [10, undefined, function(){},
Symbol('')] }));
// expected output: "{"x":[10,null,null,null]}"

console.log(JSON.stringify(new Date(2006, 0, 2, 15, 4, 5)));
// expected output: ""2006-01-02T15:04:05.000Z""
```

JS_date

The JSON.stringify() function will remove any functions from a JavaScript object, both the key and the value

Json Tutorial and reference



JS JSON

- JSON Intro
- JSON Syntax
- JSON vs XML
- JSON Data Types
- JSON Parse
- JSON Stringify
- JSON Objects
- JSON Arrays
- JSON PHP
- JSON HTML
- JSON JSONP

https://www.w3schools.com/js/js_json_intro.asp

https://developer.mozilla.org/en-US/docs/Learn/JavaScript/Objects/JSON