# Web 2.0

### **Lecture 5: Accessing and Utilizing Services**

#### doc. Ing. Tomáš Vitvar, Ph.D.

tomas@vitvar.com • @TomasVitvar • http://vitvar.com



Czech Technical University in Prague
Faculty of Information Technologies • Software and Web Engineering • http://vitvar.com/courses/w20







Modified: Sun Mar 18 2018, 22:45:18 Humla v0.3

### **Overview**

- Mashups and XHR
- Security Mechanisms
- JSON and JSONP

### **Mashups**

- Web application hybrid/Web 2.0 application
  - Uses APIs of two or more applications to provide new value-added functionality
- Types
  - Data mashup integration/aggregation of data (read only)
  - Service mashup more sophisticated workflows (read, write)
  - Visualization involves UI, e.g., third-party data displayed on the Google map
- Client-Server View
  - client-side mashups (mainly in a browser)
    - → JavaScript, Dynamic HTML, AJAX, JSON/JSONP
  - server-side mashups
    - → server-side integration of services and data
    - → third-party programming languages
    - → specialized environments: Google AppsScript
- Web Apps developments will all be about mashups!

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 3 -

## XMLHttpRequest (XHR)

- Interface to utilize HTTP protocol in JavaScript
  - standardized by Web Applications WG ♂ at W3C
  - basis for AJAX
    - → Asynchronous JavaScript and XML
- Typical usage
  - 1. Browser loads a page that includes a script
  - 2. User clicks on a HTML element
    - it triggers a JavaScript function
  - 3. The function invokes a service through XHR
    - same origin policy, cross-origin resource sharing
  - 4. The function receives data and modifies HTML in the page

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 4 -

### XHR Interface – Key Methods and Properties

- Method and properties of XHR object
  - open, opens the request, parameters:

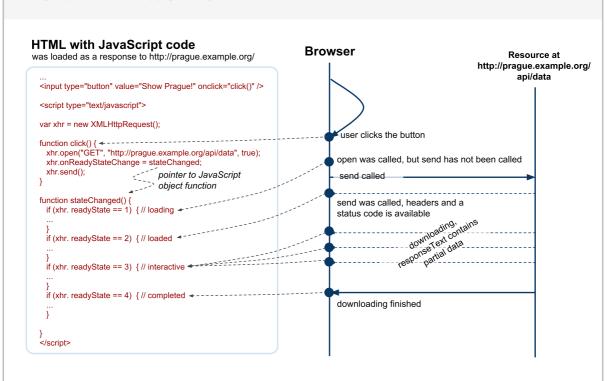
```
method — method to be used (e.g. GET, PUT, POST), url — url of the resource, asynch — true to make asynchronous call, user, pass — credentials for authentication.
```

- onReadyStateChange JavaScript function object, it is called when readyState changes (uninitialized, loading, loaded, interactive, completed).
- send, abort sends or aborts the request (for asynchronous calls)
- status, statusText HTTP status code and a corresponding text.
- responseText, responseXML response as text or as a DOM document (if possible).
- − onload − event listener to support server push.
- See XMLHttRequest (W3C) ☑, or XMLHttRequest (Mozilla reference) ☑ for a complete reference.

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 5 -

### **How XHR works**



Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 6 -

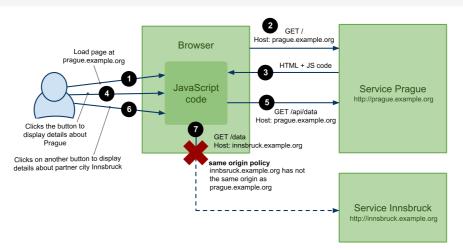
### **Overview**

- Mashups and XHR
- Security Mechanisms
  - Scripting Attacks
  - Cross-origin Resource Sharing Protocol (CORS)
- JSON and JSONP

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

-7-

# **Same Origin Policy**



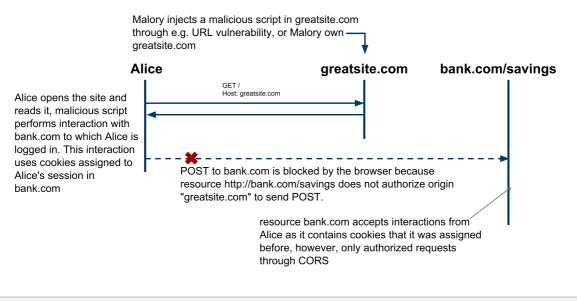
- JavaScript code can only access resources on the same domain
  - XHR to GET, POST, PUT, UPDATE, DELETE
  - Browsers apply same origin policy
- Solutions
  - JSON and JSONP (GET only)
  - Cross-origin Resource Sharing Protocol (CORS)

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 8

# Why Same Origin Policy?

• Without the same origin policy, the following POST would be possible



Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

\_ 9 -

#### **Overview**

- Mashups and XHR
- Security Mechanisms
  - Scripting Attacks
  - Cross-origin Resource Sharing Protocol (CORS)
- JSON and JSONP

#### **Overview**

### Scripting Attacks

- Intruders make users perform action that has side effects on their resources
- Intruders inject malicious code to Web pages

### • Roles in Security Scenarios

- Alice, Bob
  - → Normal users, usually Alices wants to send a message to Bob or Alice accesses a Bob's site.
- -Eve
  - $\rightarrow$  A user with bad intentions, usually a passive attacker.
- Mallory
  - → An active attacker, usually sends a link to a page with malicious code.

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 11 -

### **Recall: State management in HTTP**

### • Request-response interaction with cookies

- Session is a logical channel maintained by the server



### Stateful Server

- Server remembers the session information in a server memory
- Server memory is a non-persistent storage, when server restarts the memory content is lost!

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

– 12 -

### **Cross-site Request Forgery (CSRF)**

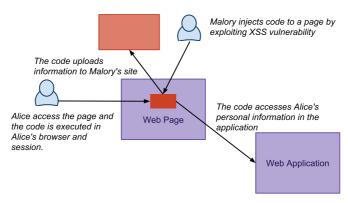
- Exploits a trust of a website in a user's browser
- Scenario
  - 1. Mallory sends a link to Alice (in an email, in a chat, etc.)
    - The link points to a page that has HTML code with hrefs to Alice's private resources
    - For example, to perform an action on Alice's account, it is possible to use img like this:
      - 1 | <img src="https://bank.com/account?do=transfer\_money&amount=50000"/>
  - 2. Alice loads the page in her browser
    - Alice is authenticated to the bank's website, the browser sends Alice's authentication cookies with the request.
- Issues and Prevention
  - The bank site vilotes REST, i.e. overloading of GET for making actions
  - The bank should check HTTP referer header
  - It is a "blind" attack, Mallory does not see the result
  - To perform POST, current browsers today use CORS protocol

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 13 -

# **Cross-site Scripting Attack (XSS)**

Exploits a trust of a user in a website



### Example Scenario

- 1. An attacker injects a code to a page
- 2. A users executes the code in his/her browser's session
- 3. The code provides information (cookies) to the attacker
- 4. The attacker uses the cookies to access the user's data

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

– 14 -

## **XSS Examples**

- Twitter in Sep 2010
  - Injection of JavaScript code to a page using a tweet
  - You posted following tweet to Twitter

```
There is a great event happening at http://someurl.com/@"onmouseover="alert('test xss')"/
```

- Twitter parses the link and wraps it with <a> element

```
There is a great event happening at

a href="http://someurl.com/@"onmouseover="alert('test xss')"

target="_blank">http://someurl.com/@"onmouseover=
    "alert('test xss')"/</a>
```

- See details at Twitter mouseover exploit ₫
- Other example: Google Contacts

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 15 -

#### **Overview**

- Mashups and XHR
- Security Mechanisms
  - Scripting Attacks
  - Cross-origin Resource Sharing Protocol (CORS)
- JSON and JSONP

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

\_ 16 -

#### Overview

- Increasing number of mashup applications
  - client-side mashups involving multiple sites
  - mechanism to control an access to sites from within JavaScript

## • Allow for cross-site HTTP requests

- HTTP requests for resources from a different domain than the domain of the resource making the request.

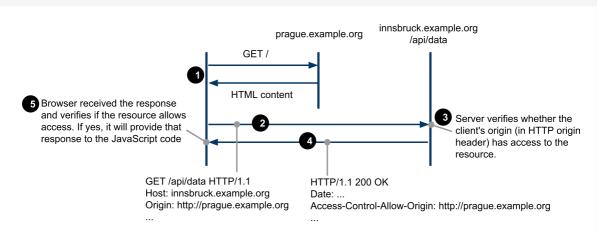
### W3C Recommendation

- Browsers support it
  - $\rightarrow$  see HTTP Access Control  $\triangleleft$  at Mozilla

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 17 -

#### **CORS Protocol – GET**



Read-only resource access via HTTP GET

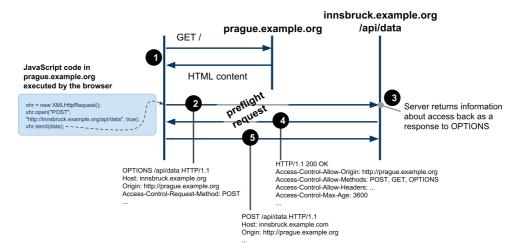
#### Headers:

- − Origin identifies the origin of the request
- Access-Control-Allow-Origin defines who can access the resource
- either the full domain name or the wildcard (\*) is allowed.

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 18 -

# CORS Protocol – other methods and "preflight"



- Preflight request queries the resource using **OPTIONS** method
  - requests other than GET (except POST w/o payload) or with custom headers
  - A browser should run preflight automatically for any XHR request meeting preflight conditions
  - The browser caches responses according to Access-Control-Max-Age

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 19 -

#### **Overview**

- Mashups and XHR
- Security Mechanisms
- JSON and JSONP

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 20

#### **Recall: JSON**

- JSON = JavaScript Object Notation
  - Serialization format for data representation
  - Very easy to use in JavaScript
    - $\rightarrow$  no need to use a parser explicitly
  - Also great support in many programming environments
- Key constructs

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 21 -

# JSON in JavaScript

Native data format

```
// data needs to be assigned
var data = { "people" : ["tomas", "peter", "alice", "jana"] };

// go through the list of people
for (var i = 0; i < data.people.length; i++) {
   var man = data.people[i];
   // ... do something with this man
}</pre>
```

- Responses of service calls in JSON
  - Many support JSON, how can we load that data?
- Example Request-Response

```
GET http://pipes.yahoo.com/pipes/pipe.run?_id=638c670c40c97b62&_render=json

{"count":1,"value":
    {"title":"Web 2.0 announcements",
        "description":"Pipes Output",
        "link":"http:\\//pipes.yahoo.com\/pipes\/pipe.info...",
        "pubDate":"Mon, 07 Mar 2011 18:27:20 +0000",
        "generator":"..."
        ...
}

}
```

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

\_ 22 \_

#### **JSONP**

- Service that supports JSONP
  - allows to specify a query string parameter for a wrapper function to load the data in JavaScript code
  - otherwise the data cannot be used in JavaScript
    - → they're loaded into the memory but assigned to nothing
- Example

```
- if a resource at http://someurl.org/json_data returns
{ "people" : ["tomas", "peter", "alice", "jana"] }

then the resource at
http://someurl.org/json_data?_callback=loadData returns
loadData({ "people" : ["tomas", "peter", "alice", "jana"] });
```

- A kind of workaround for the same origin policy
  - only GET, nothing else works obviously
  - no XHR, need to load the data through the dynamic ⟨script⟩ element

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

- 23 -

# JSONP in JavaScript

- JSONP example
  - loads JSON data using JSONP by dynamically inserting <script> into the current document. This will download JSON data and triggers the script.

Lecture 5: Accessing and Utilizing Services, CTU Summer Semester 2017/2018, @TomasVitvar

– 24 –