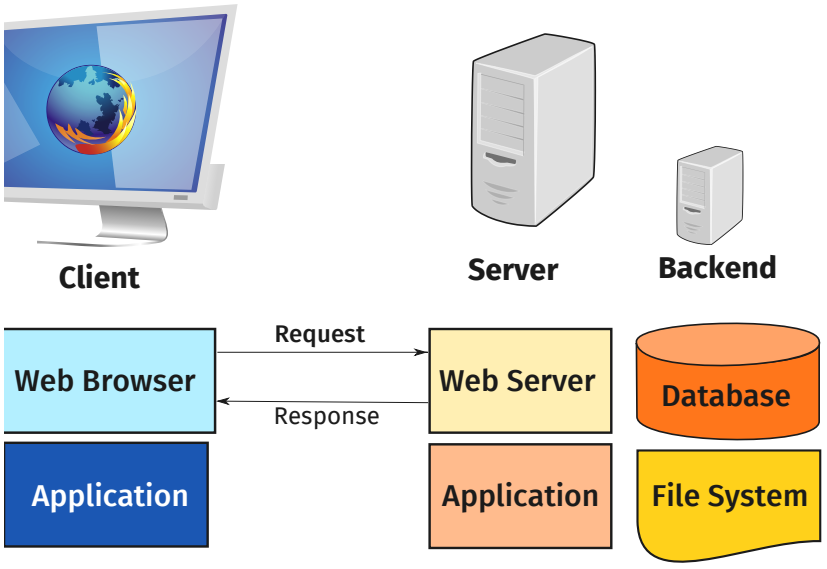
Università della Svizzera italiana

Faculty of Informatics

AJAX

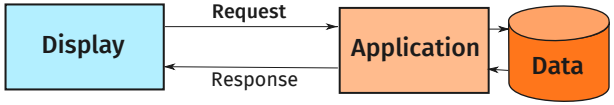
Prof. Cesare Pautasso
http://www.pautasso.info
cesare.pautasso@usi.ch
@pautasso

Web application Architecture

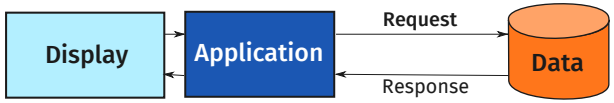


Very Thin Client

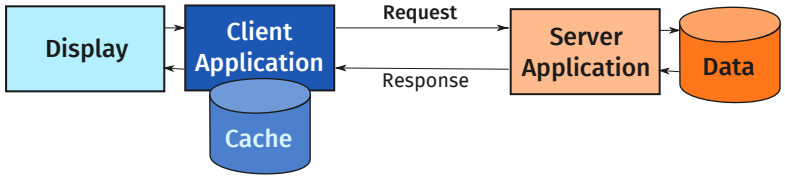
Client/Server



Rich Client



General Architecture



Rich vs. Thin Client

Rich Client

- Applications runs on the client (may use the server for storage)
- Platform Examples:
  - Windows, MacOS/X
  - Eclipse RCP/Java
- Software needs to be deployed on the client
- Zero latency
- Complete control, native access to the client platform

Thin Client

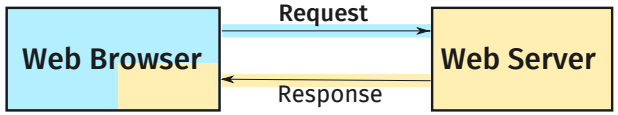
- Application runs on the server, client only perform UI tasks
- Examples:
  - Dumb Terminals
  - Web 1.0 Applications
- Zero deployment/upgrade costs
- Cannot (yet) work offline: sensitive to network failures
- Limited control, sandboxed access to the client platform

Client/Server App Structure

```
app.js
package.json
models
public/css
public/images
public/js
public/views/*.js
routes
views/*.dust
```

`public` contains static assets downloaded and executed by the browser

What about security?



Web servers should not ever run any code sent by a Web browser

Web browsers use a sandbox (secure virtual machine) to run code downloaded from a Web server

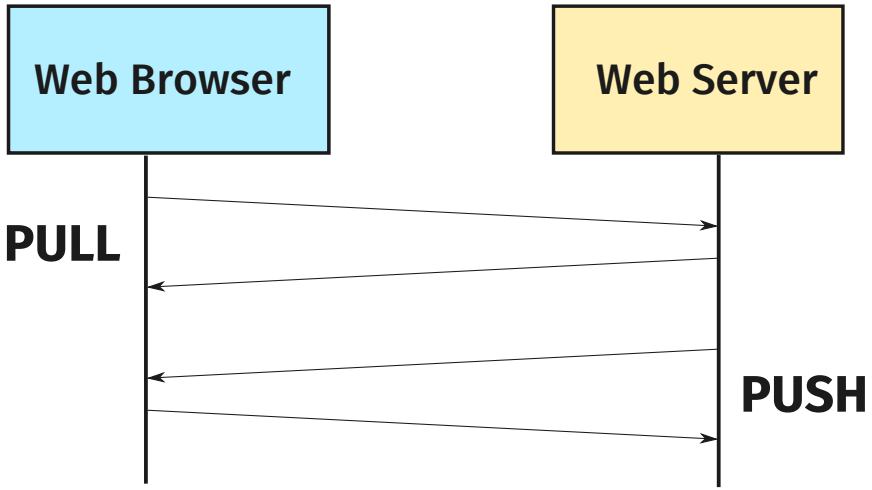
Interconnect

How to connect the client with the server?

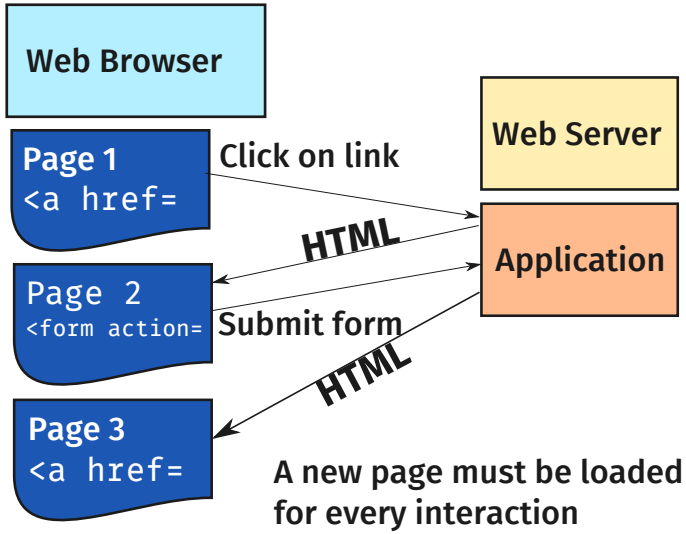
- Send user commands and input data as HTTP requests from the client to the server

How to connect the server with the client?

- **Pull**: Fetch and refresh output data
- **Push**: Notify client about state changes



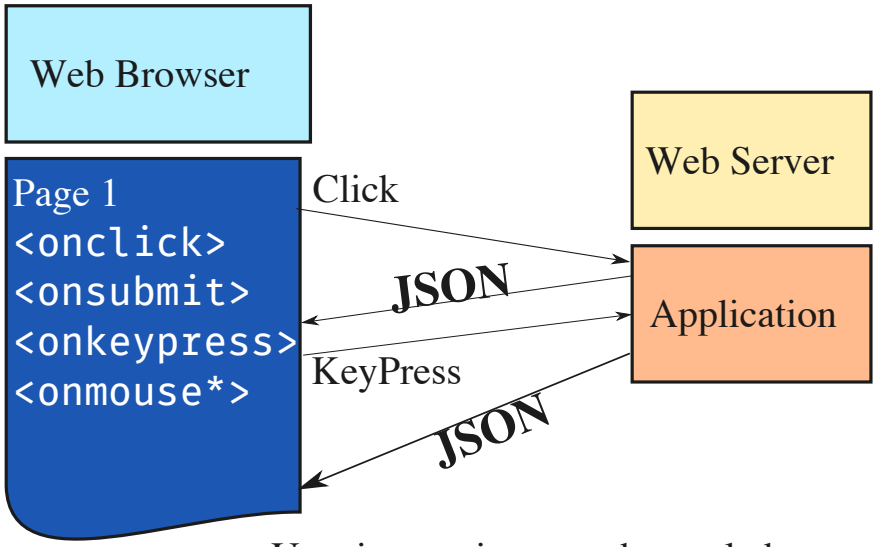
Web 1.0 Architecture



Web 1.0 Architecture - Problems

- UI not Responsive
  - The entire UI must be refreshed for every interaction, even if only parts of it need to be updated
  - The browser is blocked until the new page is downloaded from the server
- Server unnecessarily busy rendering Web pages in HTML when it could be just sending JSON and offload the rendering to the browser

Web 2.0 Architecture



User interactions are decoupled from client/server interactions

Advantages

- When the user interacts with the application we send a JSON/XML request to the server and receive a JSON/XML response back.
- The HTML rendering is done on the client
- JSON is faster, smaller, cheaper to encode, send and decode compared with XML/HTML
- Clients do not have to download the entire data but can fetch the data they need when they need it

Problems

- Since the whole application runs in the same page:
  - Back button, navigation history broken
  - Needs special handling of the "UI state" of the application
- HTTP connections are expensive:
  - Do not poll the server too often
  - Browsers limit the number of parallel connections to the same server

History Navigation

```
history.pushState(state, "title", URI);
history.replaceState(state, "title", URI);
```

Write a (new) entry in the browser history (associate URI with UI `state`)

```
window.onpopstate = function(event) {
//history state changed, synchronize the UI:
  document.location;
  document.location.hash; //#URI fragment
  event.state //UI state object
};
```

React to navigation along the history (back/forward)

```
history.back();
history.forward();
```

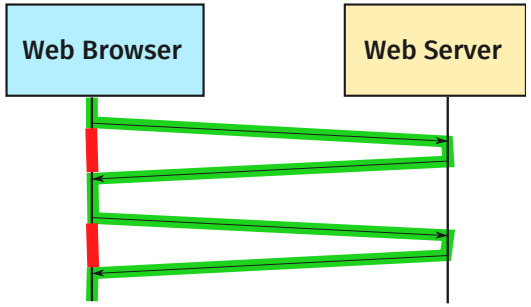
Programmatically navigate along the history

AJAX

AJAX combines different technologies:

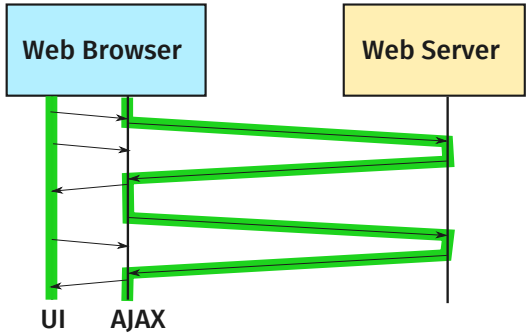
- HTML5 and CSS in the display
- Dynamic display and interaction with DOM
- Data interchange and manipulation using ~~XML/XSLT~~ (JSON)
- Asynchronous data retrieval with XMLHttpRequest
- Javascript binding everything together

Synchronous Interaction



The user waits for the server to process each request

Asynchronous Interaction



The UI thread is never blocked since server interactions run in the background

XMLHttpRequest (GET, Synch)

```
function GET(url) {
  var r = new XMLHttpRequest();
  r.open("GET", url, false);
  r.send(null);
  //this will continue after the response has arrived
  if (r.status == 200)
    return r.responseText;
  else
    //handle error
}
```

`false` = synchronous

`responseText` contains the JSON string to be parsed

XMLHttpRequest (GET, Asynch)

```
function GET(url, callback) {
  var r = new XMLHttpRequest();
  r.open("GET", url, true);
  r.onreadystatechange = function() {
    if (r.readyState == 4) {
      if (r.status == 200)
        callback(r.responseText);
      else
        //handle error
    }
  }
  r.send(null);
  //this will continue immediately
}
```

`true` = asynchronous

readyState	
0	uninitialized
1	opened
2	sent
3	receiving
4	complete

XMLHttpRequest (POST, Asynch)

```
function POST(url, params, callback) {
  var r = new XMLHttpRequest();
  r.open("POST", url, true);
  r.onreadystatechange = function() {
    if (r.readyState == 4) {
      if (r.status == 200)
        callback(r.responseText);
    }
  }
  r.setRequestHeader("Content-Type",
                     "application/x-www-form-urlencoded");
  r.send(params);
  //this will continue immediately
}
```


References

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