Assignment, part 2

Statement and concepts

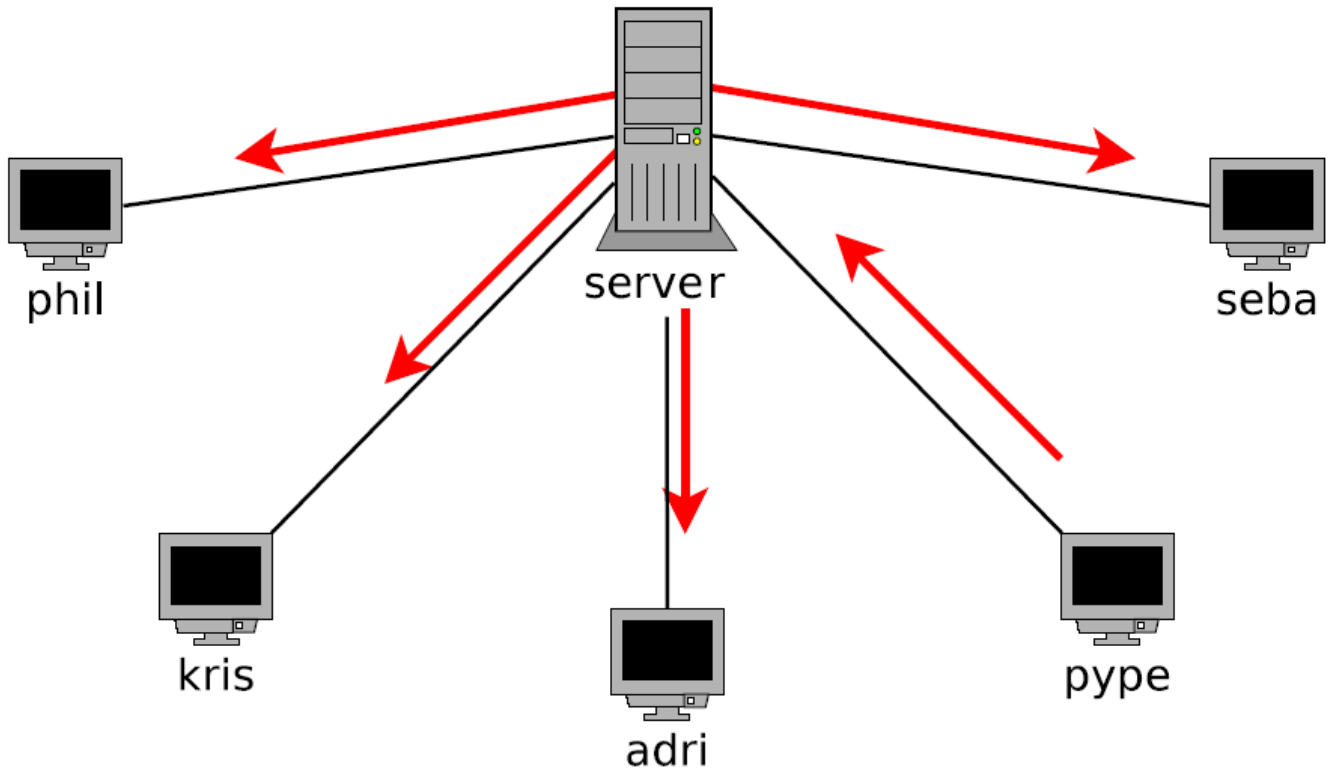
INFO-0010

Outline

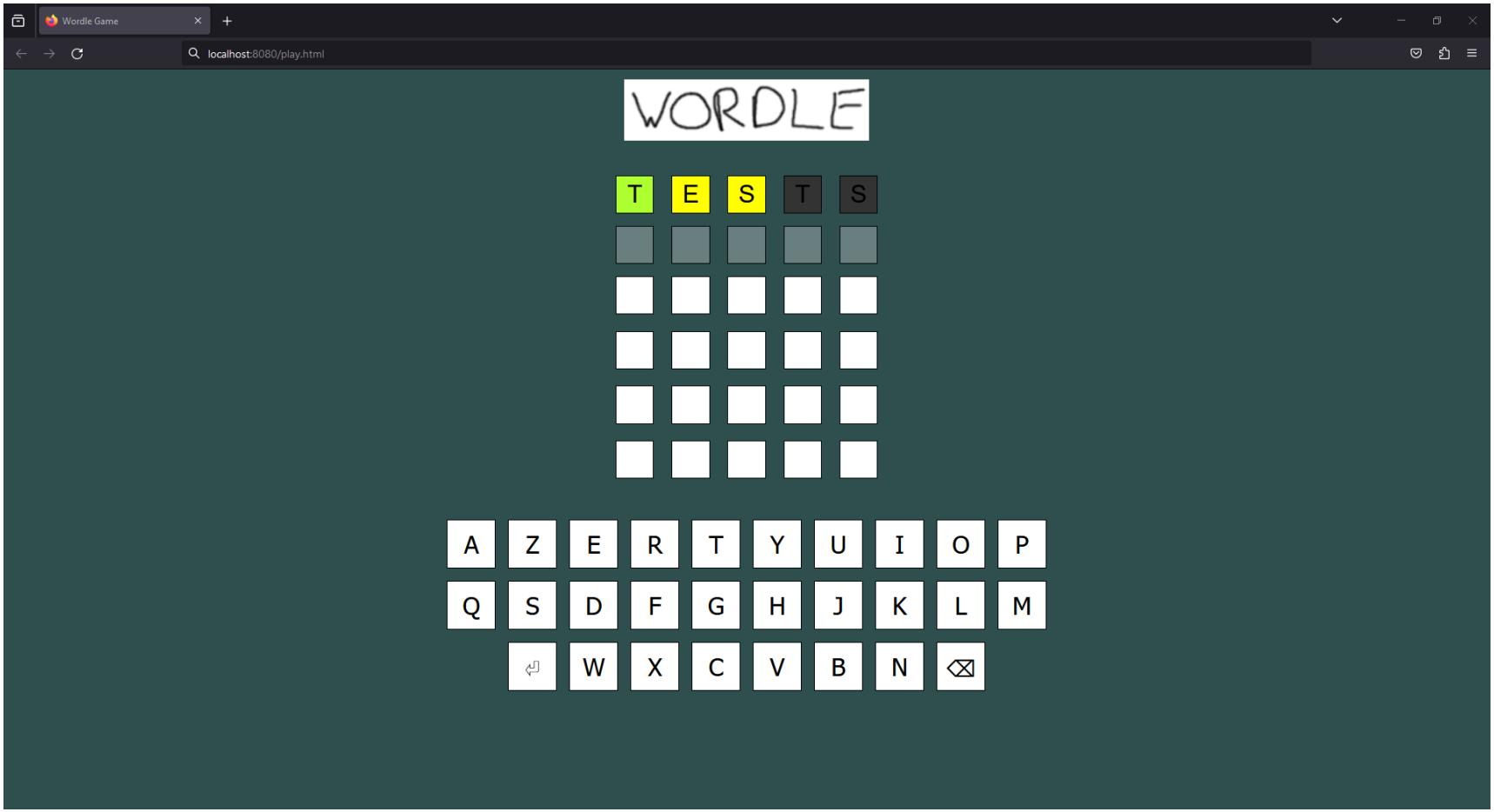
- Statement
- Implementation of concepts

Objective

Mastermind game using HTTP GET and HTTP POST methods



The platform

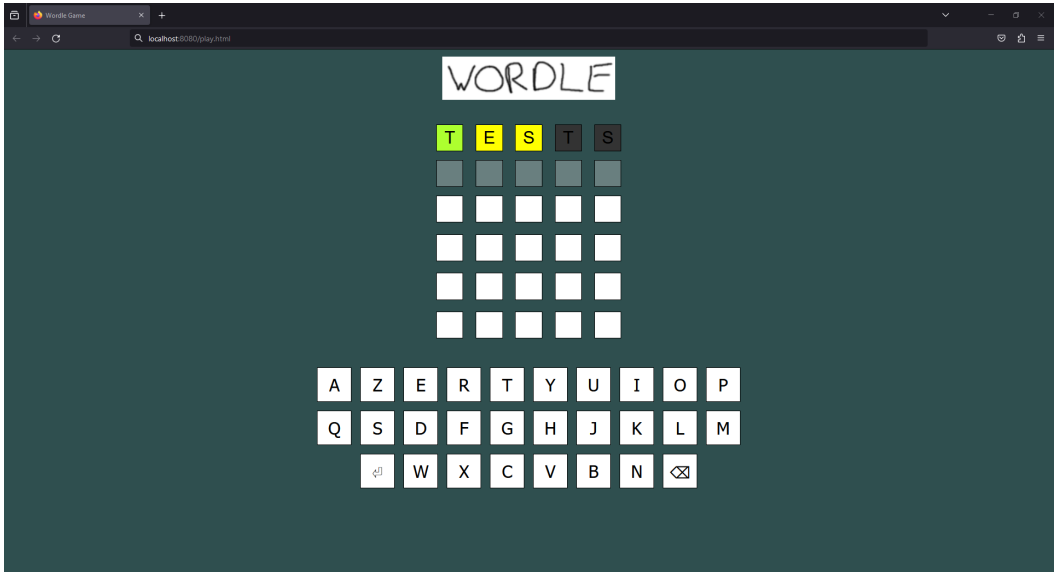


Architecture

Root page ("/")

redirection

/play.html



Protocol

1. Request webpage

2. Send webpage, including javascript

3. User clicks on enter, AJAX request

4. Response arrive

5. Guess colored by Javascript using response. Ready for new AJAX requests

Javascript disabled? Replace the form with a traditional POST one (reload entire page).

Protocol

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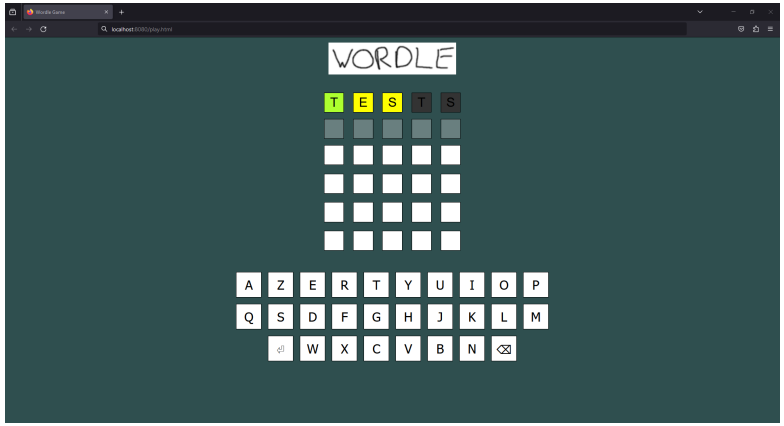

2. Send webpage, including javascript

3. User clicks on enter, AJAX request

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Javascript disabled? Replace the form with a traditional POST one (reload entire page).

Sessions

- HTTP is a *stateless* protocol.
  - For each request, the browser usually* opens a new TCP connection, send the HTTP request, receives the response, displays the content, then closes the TCP connection.
- But the user wants the server to keep track of where he left off during the game.
- Solution? Sessions.
- On the first connection, the server generates a *cookie* that is sent to the client. This cookie is sent back by the browser at each HTTP request, such that the server can keep a trace of the session state.

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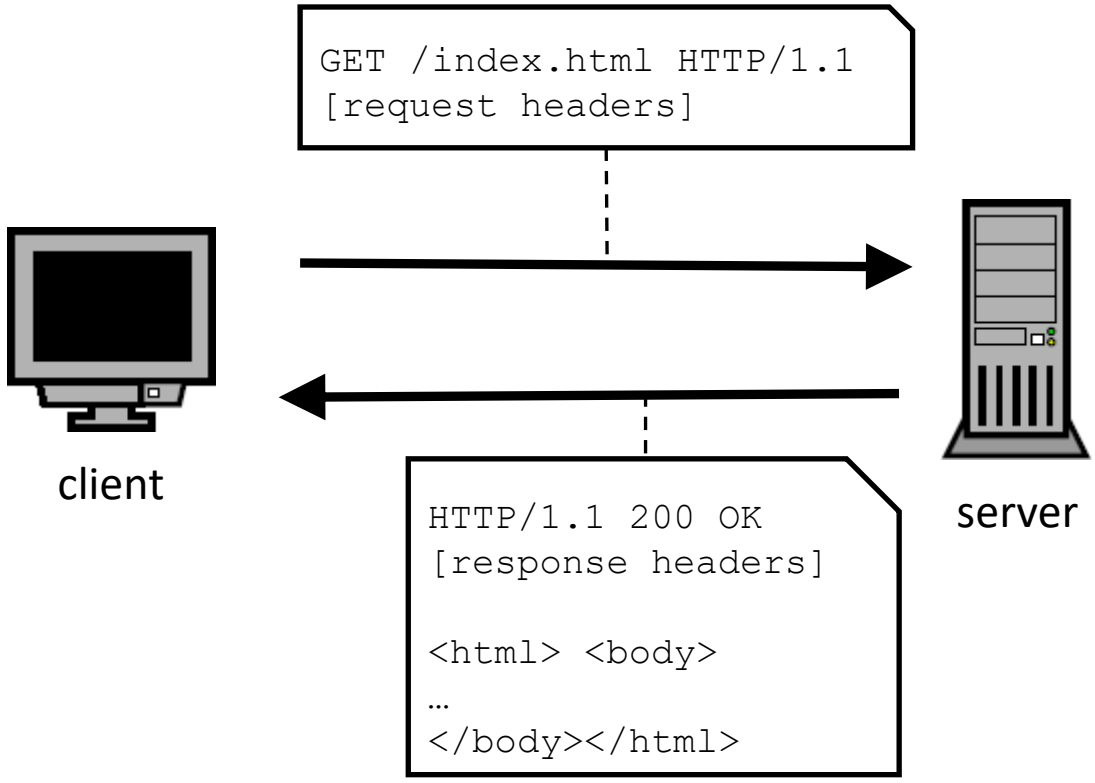
*Unless specified in the options, see later

Outline

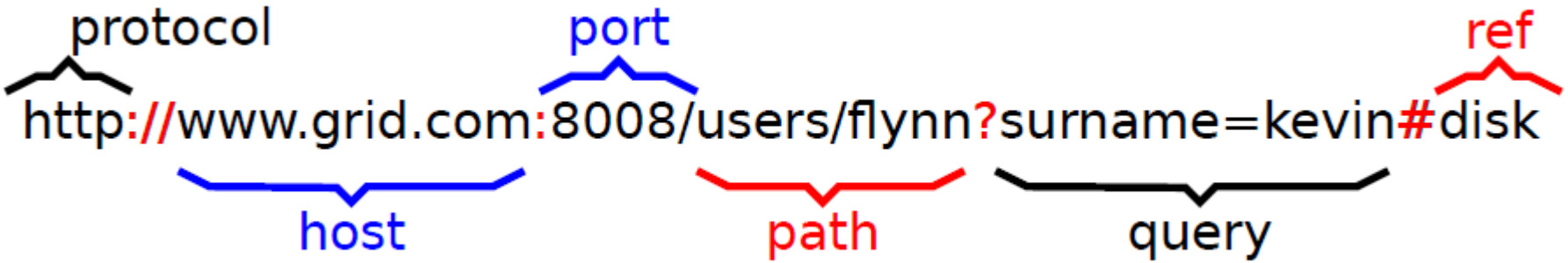
- Statement
- Implementation of concepts

The HTTP protocol



- Applicative protocol over TCP.
- Retrieve resources (files, web pages) on a machine
- Text-oriented protocol (vs. e.g. binary BitTorrent)
- Options (content-type, length, etc) : cf RFC2616

Java.net.URL



- Internet resources and services are typically identified and located through Uniform Resource Identifier/Locator.
- beware : parsing them properly is harder than you might think.

  Many fields are optionals,
- `u=new URL(<string>)` creates an internal object from an URL, ready to use
- accessor methods extract parts you need, e.g. `u.getPort()`
- make sure you use what is expected by the protocol

(e.g. `GET /path?query HTTP/1.1`, no host, no ref, no port here !)

HTTP example

```
GET /pixs/bilourun3b.gif HTTP/1.0CRLF
User-Agent : Wget/1.12 (linux-gnu)CRLF
Accept : */*CRLF
Host : dsgametools.sf.net[1]CRLF
Connection : Keep-Alive[2]CRLF
CRLF
```

```
HTTP/1.1 200 OKCRLF
Server : Apache/2.2.3 (CentOS)CRLF
Last-Modified : Wed, 17 Feb 2010
09 :14 :23 GMTCRLF
ETag : "3a6-47fc846b079c0"CRLF
Cache-Control : max-age=259200CRLF
Expires : Sun, 06 Mar 2011
21 :15 :26 GMTCRLF
Content-Type : image/gifCRLF
Content-Length : 936CRLF
Date : Thu, 03 Mar 2011 21 :15 :26
GMTCRLF
Connection : keep-aliveCRLF
CRLF
GIF89a[3].....`.@h.8..X.0x.8.85
@...P..................... !.......
!..NETSCAPE2.0...
```

---

1. Mandatory
2. Better use `Connection: close` for your tests
3. Binary content. Charset settings are important in that case.

HTTP response codes

- The first digit of the response code classifies the category of the response:
  - 1xx : Information
  - 2xx : Successful
  - 3xx : Redirection
  - 4xx : Client Error
  - 5xx : Server Error

HTTP response codes

- HTTP uses a few dozens of codes, and considering all of them is outside the scope of this assignment.
- However, I expect you to use the following codes:

- 200 : OK
- 303 : See Other
- 400 : Bad Request
- 404 : Not Found
- 405 : Method Not Allowed
- 411 : Length Required
- 501 : Not Implemented
- 505 : HTTP Version Not Supported

POST methods

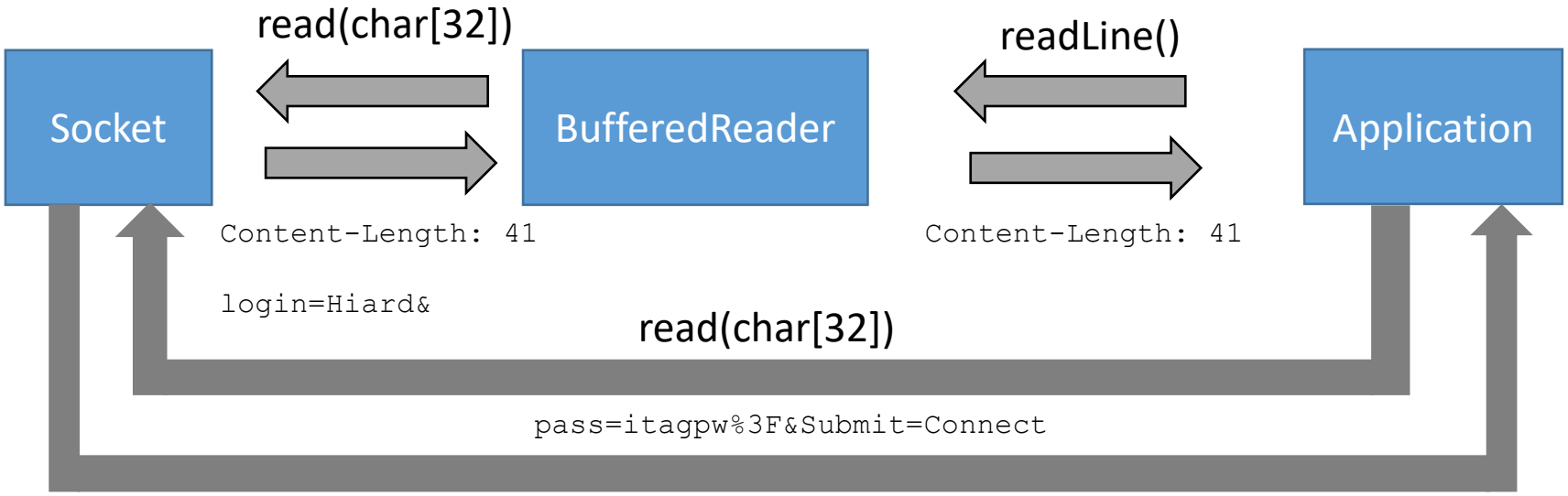
- Content follows the header
- `Content-Length` field

```
POST /identification.HTML HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (Windows NT 6.3; WOW64; rv:36.0) Gecko/20100101 Firefox/36.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: fr,fr-FR;q=0.8,en-US;q=0.5,en;q=0.3
Accept-Encoding: gzip, deflate
Referer: http://localhost/
Connection: keep-alive
Content-Type: application/x-www-form-urlencoded
Content-Length: 41

login=Hiard&pass=itagpw%3F&Submit=Connect
```

Beware of BufferedReader

- BufferedReader makes buffered reads!
  - i.e. maybe it already read more on the Socket than what you requested

```
...
Content-Length: 41

login=Hiard&pass=itagpw%3F&Submit=Connect
```



Redirections

- Automatically makes the browser request another page without the need for the user to do anything.
- At least two ways:

```
HTTP/1.1 303 See Other
Location: http://localhost:8088/viewImages.html
```

or

```
HTTP/1.1 200 OK
Content-Length: 53
(other header fields)

<script>document.location="viewImages.html";</script>
```

- In this work:
  - Redirection to `/play.html` when `/` is requested

(Session) cookies

- Setting a cookie:

```
Set-Cookie: SESSID=rk64vvmhlbt6rsdfv4f02kc5g0; path=/
```

The browser will automatically include

```
Cookie: SESSID=rk64vvmhlbt6rsdfv4f02kc5g0
```

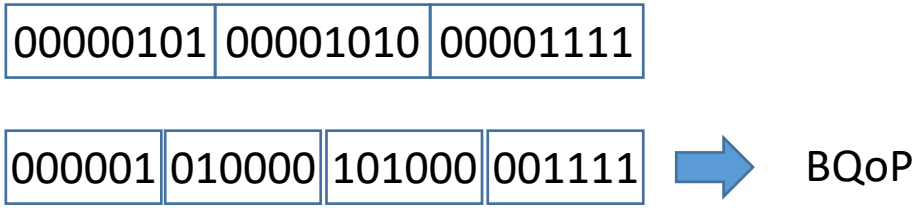
in all of its requests.

- Invalidating a cookie:

```
Set-Cookie: SESSID=deleted; path=/; expires=Thu, 01 Jan 1970 00:00:00 GMT
```

Base64

- Convert binary data into ASCII characters (e.g. for transferring images)
- 3 bytes → 24 bits → 4 groups of 6 bits
  - If less than 3 bytes, use padding (fill with 0's)
- Each of the 64 possible values is assigned to an ASCII character
- Used to encode an image in this assignment
- Example: 5 10 15 (decimal)



- Display a base64 image inside HTML

HTML

- A HTTP response usually contains a HTML webpage.
- HTML is a tag-oriented programming language.
- A tag is a character string starting with "<" and ending with ">", e.g. ,, , <p>, …
- Tags allow to structure the document, change the display of the content, add non-textual elements, …
- When a tag is opened, it should be closed (adding "/" as first character of the tag), e.g. " ".
  - OK : This text in bold and italic.
  - KO : This text in bold and italic.</html>
  - KO : This text in blod and italic.
- A good HTML tutorial : https://www.w3schools.com/html/

Javascript

- Generated by the server (inside the returned webpage)
- Executed by the client
- Inside <script> tags
- Can be disabled (use <noscript>)
- Example:

```
<HTML>
  <HEAD>
    <TITLE> Welcome to my site</TITLE></HEAD>
  <BODY>
     <SCRIPT LANGUAGE="JAVASCRIPT">
       <!--
          alert("Welcome to my site!");
       // -->
     </SCRIPT>
     <NOSCRIPT>This browser does not support javascript</NOSCRIPT>
  </BODY>
</HTML>
```

Monitoring events

- Javascript can help you monitor what's happening on the page (e.g. mouse click, key pressed, …)
- Attach a function to an event
  - on<eventname> : DOM0
  - addEventListener : DOM2
- Example :

```
<script>
  function WhichButton(event) {
    alert("You pressed button: " + event.button)
  }
</script>

<div onmousedown="WhichButton(event);">Click this text </div>
```

AJAX requests

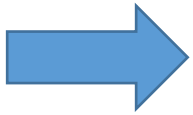
- Create a (short) request to the server, such that the entire reloading of the page is not necessary
- Use XmlHTTPRequest to create your request
- Use document.getElementByID to locate the tag you want to update
- Use innerHTML to update the content inside a tag, or specify an attribute to change inside a tag

```
var xhttp = new XMLHttpRequest();
xhttp.onreadystatechange = function() {
   if (this.readyState == 4 && this.status == 200) {
      // Action to be performed when the document is read;
      document.getElementByID("mytext").value = 'Ready';
   }
};
xhttp.open("GET", "filename", true);
xhttp.send();
```

Chunked encoding

- With "regular" transfers (i.e. HTTP/1.0), the server has to know the last byte to send (therefore, the size of the entire message) before being able to start the transmission of the first byte (since `Content-Length` is in the header).
- HTTP/1.1 offered a new way of transmitting data : chunked encoding.
- The message is split into chunks of data, each chunk being sent as soon as available, preceded with its size, in hexadecimal.
- E.g.:

```
HTTP/1.1 200 OK
Content-Type: text/plain
Transfer-Encoding: chunked

18
This is a first chunk.

1A
And this is another one.

1C
But this one is cut in half
17
without carriage return
0
```



```
This is a first chunk.
And this is another one.
But this one is cut in half without carriage return
```

Gzip compression

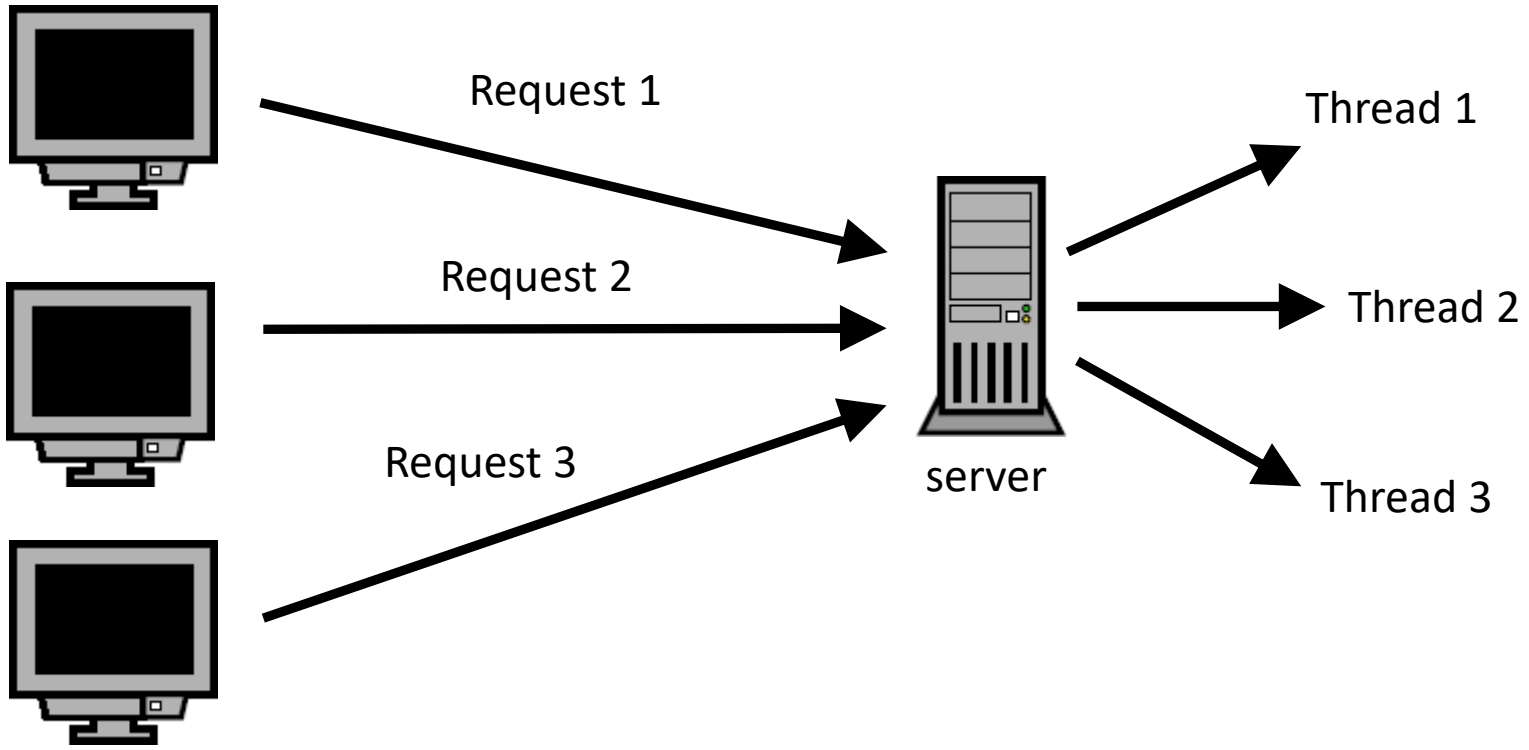
- As webpages were tending to become larger over time, the need for compression soon arose (otherwise, the ratio goodput/throughput could be quite low).

- Compression can be acheived by passing data into a `GZipOutputStream`, and transmit the output of that stream.
  - However, this is now binary data, not text (so, ensuring that both sides use the same `charset` is important)
  - Compression is done firstly, then performing chunked encoding on the compressed data is done secondly.

- For bonus points, you can implement Gzip compression.

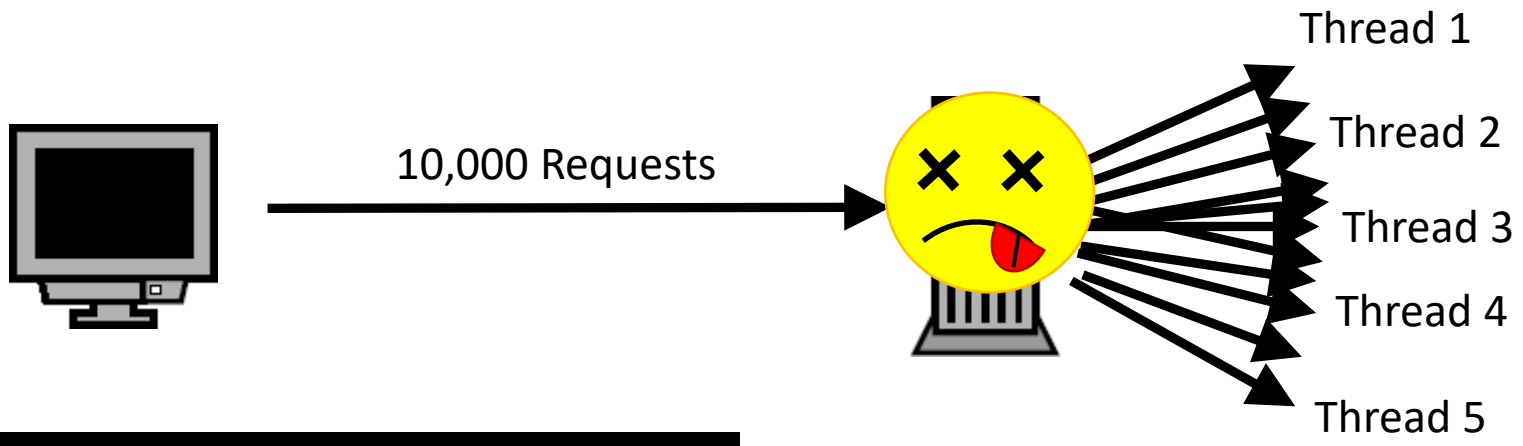
Thread pools

- Previously:



Thread pools

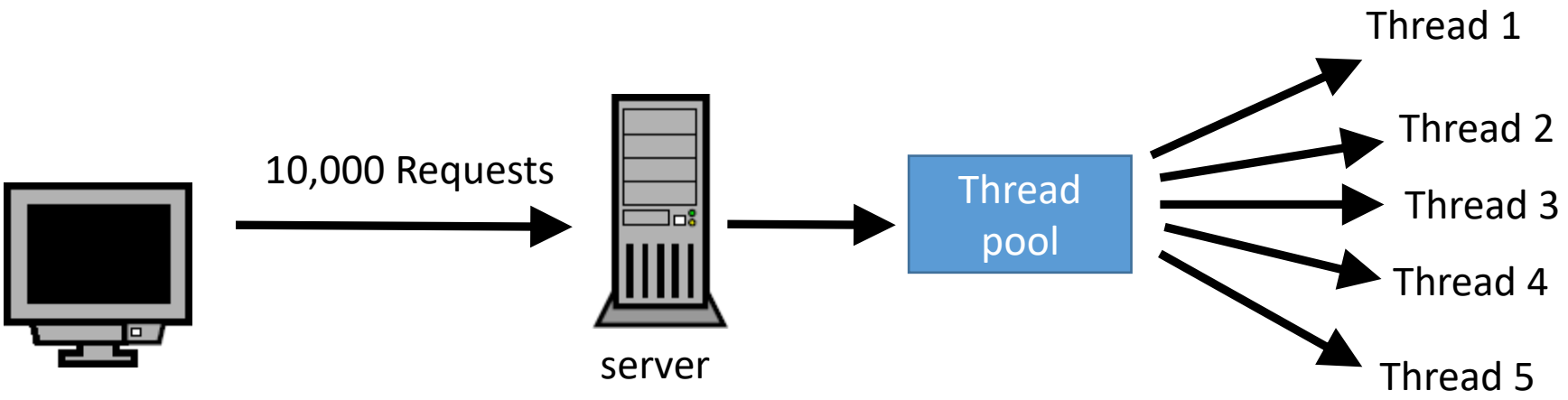
- Imagine the following attack:




```
Socket[] s = new Socket[10000];
for(int i = 0; i < 10000; i++)
{
     s[i] = new Socket("100.100.100.100",80);
}
```

Thread pools

- With a thread pool:



1. Handle the first 5 requests (9,995 remaining)
2. As soon as a thread finishes, it returns to the pool and receives a new task
3. When all tasks are done, each thread is back in the pool, ready for new tasks

Possible loss of speed performance, but increased robustness

Guidelines

- Deadline : 11th of December.
- Work by groups of two students.
- Check that your program works on ms8** machines with Firefox (Don't have an account? Contact Marc Frédéric). Launch the server on a given machine, and try to access it from a different machine.
- Guidelines of the first part still apply (Java 1.8, no package instructions, don't intercept CTRL-C, …).