**Session Plan: HTTP Protocol**

**Objective**

In this lecture, the students should be introduced to the Internet protocol – HTTP (Hypertext Transfer Protocol).   
They will also be introduced to concepts such as URLs. They will find out more about the HTTP request and HTTP response. They will look at the different MIME and Media types. They will look again at Web Servers, as well as get acquainted with Html Forms.

**Motivation**

This topic aims to introduce students to HTTP basically so that they can then easily understand how a web application works.

**Content**

### HTTP Basics (~20 min)

* **What is a Protocol?**
  + A **communication** protocol is a **set of rules**, which define how two or more parties are talking to each other.
  + It is like a common language used for communication between machines.
* **HTTP**
* **HTTP Protocol**
  + **H**yper**T**ext **T**ransfer **P**rotocol
  + **Text-based client-server** protocol
  + **General-purpose client-server** protocol used to **transmit data** across the web
    - For transferring Web resources (HTML files, images, styles, etc.)
  + Relies on **URLs**
  + Stateless
    - Each HTTP request is **independent** from the others
    - Cookies and Web storages can overcome this
  + Uses the **request-response model**
* **HTTP Conversation: Example**

### URL (~10 min)

* **Uniform Resource Locator (URL)**
  + Formatted string, consisting of:
    - Network protocol (**http**, **ftp**, **https**...) – HTTP in most cases
    - **Host** or **IP** address (**softuni.org**, **gmail.com**, **127.0.0.1**, **web**)
    - **Port** (the default port is **80**) – integer in the range [**0…65535**]
    - **Path (/forum, /path/index.php)**
    - **Query string** (**?id=27&lang=en**)
    - **Fragment** (**#slides**)– navigate to some section in the page
* **URL Encoding**
  + URLs are encoded according RFC 1738
  + Safe URL characters: **[0-9a-zA-Z]**, **$**, **-**, **\_**, **.** , **+**, **\***, **'**, **(**, **)**, **,**, **!**
  + All other characters are escaped by

|  |
| --- |
| **%[character hex code]** |

* + Space is encoded as "**+**" or "**%20**"
  + URL-encoded string
* **Valid and Invalid URLs – Examples**

### Q&A [Sli.do] (~5 min)

### HTTP Request (~20 min)

* **HTTP Request Message**
  + HTTP request line
    - Request method (**GET** / **POST** / **PUT** / **DELETE** / …)
    - Resource URI (**URL**)
    - Protocol version
  + **HTTP request headers**
    - Additional parameters
  + **HTTP request body** – optional data, e.g.. posted form fields
* **HTTP Request Methods**
  + **HTTP**defines**methods**to indicate the desired action to be performed on the identified resource
* **HTTP GET Request**
  + **GET** is used to request data from a specified resource
  + Example of HTTP **GET** request
* **HTTP POST Request**
  + The **POST** method transfers data in the HTTP body
  + Example of HTTP **POST** request

### Q&A [Sli.do] (~5 min)

### BREAK: 15 min

### HTTP Response (~20 min)

* **HTTP Response Message**
  + The **response message** sent by the HTTP server consists of
    - **HTTP response status line**
      * Protocol version
      * Status code
      * Status phrase
    - **Response headers**
      * Provide metadata about the returned resource
    - **Response body**
      * The content of the HTTP response (data)
* **HTTP Response – Example**
* **HTTP Response Codes**
  + **HTTP response code classes**
    - **1xx: informational**
    - **2xx: successful**
    - **3xx: redirection**
    - **4xx: client error**
    - **5xx: server error**
* **HTTP Error Response – Example**
* **Browser Redirection**
  + HTTP GET requesting a moved URL
  + The following HTTP response (301 Moved Permanently) tells the browser to request another URL
* **Content-Type** and **Disposition**
  + The **Content-Type** response header specifies how the output should be processed
  + Examples

### Q&A [Sli.do] (~5 min)

### MIME (~15 min)

* **What is MIME?**
  + [**MIME**](http://en.wikipedia.org/wiki/MIME)== **M**ulti-Purpose **I**nternet **M**ail **E**xtensions
    - Internet standard for encoding resources
    - Originally developed for email attachments
    - Used in many Internet protocols like HTTP and SMTP
  + MIME defines several concepts
    - **Content-Type**, e.g. **text/html**, **image/gif**, **application/pdf**
      * Content **charset**, e.g. **utf-8**, **ascii**, **windows-1251**
    - **Content-Disposition**, e.g. **attachment;** **filename=logo.jpg**
    - Multipart messages (multiple resources in a single document)
* **Common MIME Media Types**

|  |  |
| --- | --- |
| **MIME Type / Subtype** | **Description** |
| application/json | JSON data |
| image/png | PNG image |
| image/gif | GIF image |
| text/html | HTML |
| text/plain | Text |
| text/xml | XML |
| video/mp4 | MP4 video |
| application/pdf | PDF document |

### Q&A [Sli.do] (~5 min)

### Routing (~10 min)

* What is Web Routing?
  + **Routing** is is a mechanism where **HTTP requests** are **routed** to the **code that handles them**
    - Requests are routed based on the **HTTP request method** and the **request path**
    - **HTTP requests** are mapped to **HTTP responses**
    - Example: route "**/**" is often mapped to the app's **Home page**
* **Mapping Physical Files**

### BREAK: 15 min

### HTTP Tools (~20 min)

* **HTTP Tools for Developers – Browser**
* **HTTP Tools for Developers**
  + Insomnia Rest
  + Postman
  + RESTClient

### Q&A [Sli.do] (~5 min)

### Web Server ( ~15 min)

* **What is a Web Server?** 
  + Computer system that processes requests via HTTP, the basic network protocol
* Web Server Work model
* Most Popular Web Servers

### Q&A [Sli.do] (~5 min)

### Html Form (~15 min)

* **Action Attribute**
  + Defines where to submit the form data
* **Method Attribute**
  + Specifies the HTTP method to use when sending form data
* **URL Encoded Form Data – Example**
* **GET** vs **POST** method
  + **GET**
    - Values are contained in the **URL**
    - Has a length limitation of **255** **characters**
    - It is **often** cacheable
    - Supports only **string** **data** **types**
    - Parameters **are** **saved** in browser history
    - Results **can** be bookmarked
  + **POST**
    - Values are contained in the **message's body**
    - Does **not** **have** a length limitation
    - It is **hardly** cacheable
    - Supports **different data types**
    - Parameters **are not saved** in browser history
    - Results **cannot** be bookmarked

### BREAK: 10 min

### Q&A [Sli.do] (~5 min)

### HTTP/2 (~10 min)

* **What's HTTP/2**
  + HTTP/2 (originally named HTTP/2.0) is a major revision of the **HTTP** network protocol used by the **World Wide Web**
    - Supported by most of the popular web browsers (Chrome, Mozilla, Opera, ...)
    - Fast & Optimized. Meets modern web usage requirements.
    - Completely Backwards-Compatible.
  + As of April 2023, **40**% of all the websites support **HTTP/2** (W3Techs statistics)
* **What's New?**
* **What's Better?**
  + **HTTP/2** is meant to erase the need of maintaining complex server infrastructures in order to perform well
  + **HTTP/2** communicates in binary data frames
  + **HTTP/2** introduces several new important elements
    - HTTP/2 Multiplexing
    - HTTP/2 Header Compression
    - HTTP/2 Server Push
* **Multiplexing**
  + The art of handling multiple streams over a single TCP connection
* **Header Compression**
  + **HTTP/2** maintains a **HTTP** **Header Table** across requests
  + Optimizes communication drastically
  + The process is essentially a **de-duplication**, rather than compression
* **HTTP/2 Server Push**
  + The process of sending resources to clients, without them having to ask for it

### HTTP/3 (~10 min)

* **What's HTTP/3**
  + HTTP/3 is a new standard in development that will affect how web browsers and servers communicate
  + As of Aug 2022, HTTP/3 is supported by 25% of web browsers (W3Techs statistics)
  + Uses **QUIC** Protocol
* **What's new?**
  + **Significant upgrades** for user experience
    - Decreasing the effects of packet loss
    - Workaround for the slow performance, e. g. when a smartphone switches from Wi-Fi to cellular data
  + **Performance**, **Reliability** and **Security**

### Q&A [Sli.do] (~5 min)

**Exercise**

Because this is a theoretical topic, there are no practical exercises.

**Evaluation & Exam**

Because this is a theoretical topic, it is not included in the final exam.