Online Multimedia

Winter Semester 2019/20

Tutorial 10 – Media Inputs & Streaming

Today's Agenda

- Quicktest 😀
- Media Input without Browser Plugins
- WebSocket
- Quiz

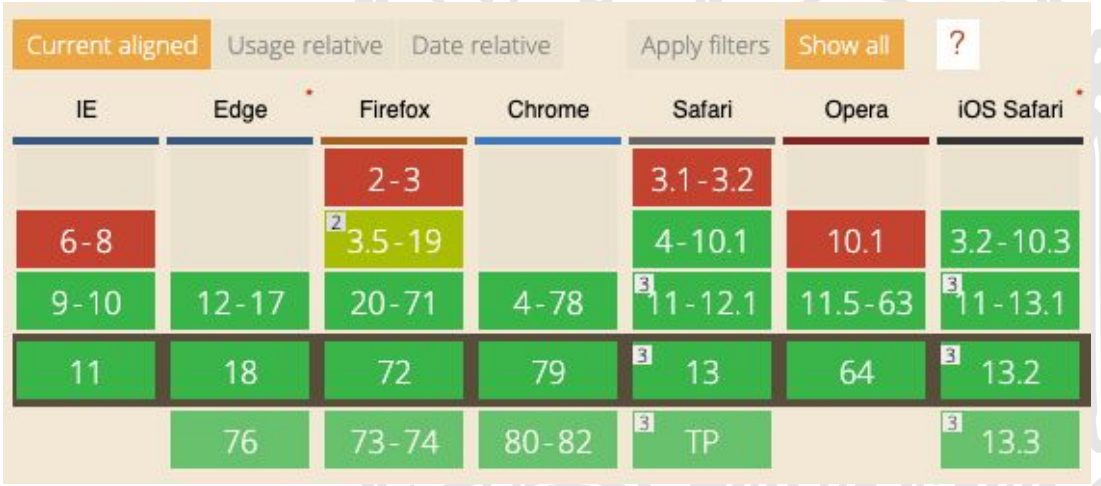
Quick Test #03

Media Input without Browser Plugins

Video and Audio in Browser

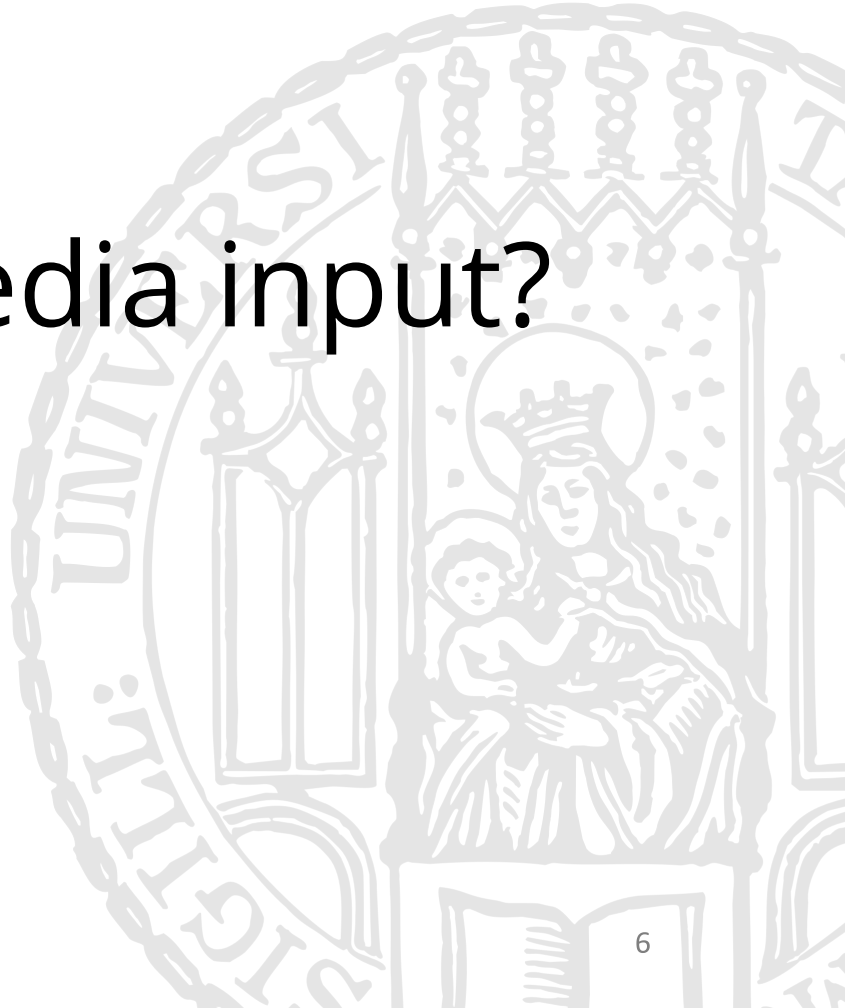
- Simple, unidirectional streaming possible with the **<video>** and **<audio>** tags
- Before HTML5, browser plugins were necessary to play multimedia content
- MP3/MP4 is supported in most browsers:

```
<audio src="./sound.m4a"></audio>
<video controls width="250">
    <source src="/video.webm"
            type="video/webm">
    <source src="/video.mp4"
            type="video/mp4">
    Video element is not supported.
</video>
```



https://caniuse.com/#feat=video

How do we achieve multimedia input?



HTML5, JavaScript and Media Capture

- Goal: access audio/video through HTML
- Capturing used to rely on plugins (e.g. Flash, Silverlight, Quicktime, Java Applets)
- **HTML5 brings audio/video capturing functionality!**
- Part of the WebRTC effort (more on this in future tutorials)

Media Devices API

- Synchronized media streams, i.e. synchronized audio & video streams in the Browser.
- Streams have inputs (e.g. camera) and an output
- Most important method:

```
navigator.mediaDevices
.getUserMedia(constraints).then(successCallback).catch(errorCallback)
```

- MediaStream object returned to successCallback:

```
{
  active: true,
  id: "Cp7wyEAYPZCFTzFkUDjN9R2xxzRqo4fzaueW",
  onactive: null,
  ...
}
```

MediaDevices API Browser Support

https://caniuse.com/#search=getusermedia

Availability Check

01-availability.html

```
<script>
 function isMediaDevicesCapable() {
   return navigator.mediaDevices &&
     navigator.mediaDevices.getUserMedia;
 }
 if (isMediaDevicesCapable()) {
   document.write('mediaDevices.getUserMedia supported');
 } else {
   document.write('sorry, mediaDevices.getUserMedia unsupported');
 }
</script>
```

Permissions

- `getUserMedia()` usually generates a built-in browser dialog
- Permissions are requested with a JSON Object as first parameter:

```
let requestedPermissions = {
    audio: true,
    video: true
};
```

Simple A/V Capture Script

02-permissions.html

```
<script>
 let video = document.querySelector('video');
 if (navigator.mediaDevices.getUserMedia) {
   navigator.mediaDevices.getUserMedia({ audio: true, video: true })
    .then(function(stream) {
      video.srcObject = stream;
   }).catch(function(error) {
      document.write(error);
   });
 }
</script>
```

Taking Video Snapshots

03-snapshots.html

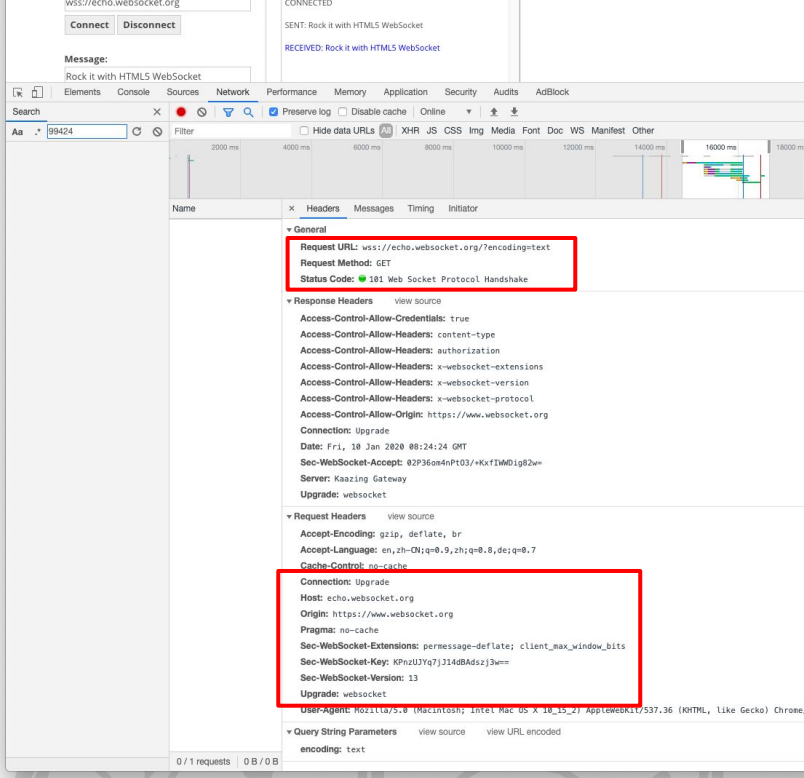
```
<video autoplay></video>
<script> let video = document.querySelector('video'), canvas;
   navigator.mediaDevices.getUserMedia({video: true}).then(function(stream) {
     video.src = stream;
     video.addEventListener('click', () => {
       let img = document.querySelector('img') || document.createElement('img');
       let width = video.offsetWidth, height = video.offsetHeight, context;
       canvas = document.createElement('canvas');
       canvas.width = width; canvas.height = height;
       context = canvas.getContext('2d');
       context.drawImage(video, 0, 0, width, height);
       img.src = canvas.toDataURL('image/png');
       document.body.appendChild(img);
  })})
</script>
```

Breakout

- Play a "camera shutter" sound when the user takes a snapshot!
- A sound file is included in the material for this tutorial
- Sound file source (Creative Commons):
  https://www.freesound.org/people/xef6/sounds/61059/

WebSocket

WebSocket



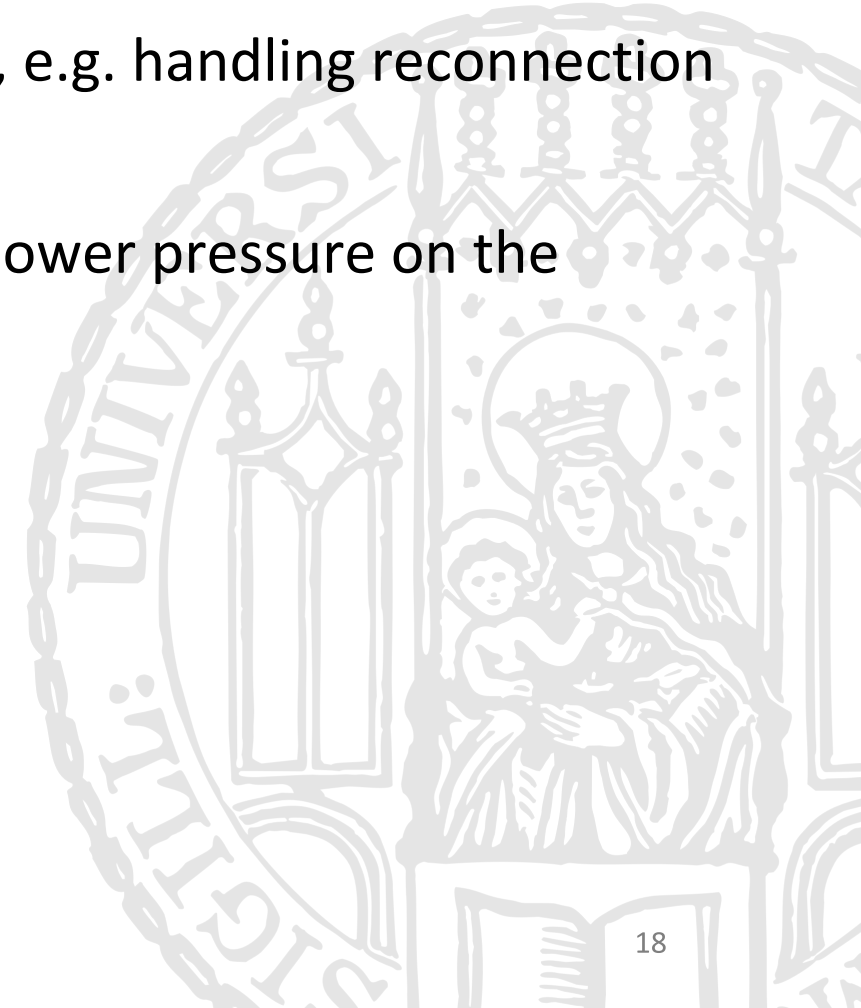
- Basic ideas
  - TCP based, bidirectional, full-duplex messaging
  - Establish connection (single TCP connection)
    - **Bidirectional**: Send messages in both direction
    - **Full Duplex**: Send message each other independently
- Allow you stream data to and from web browsers.
- **The socket starts out as a HTTP connection and then "*Upgrades*" to a TCP socket after a HTTP handshake. After the handshake, either side can send data.**

WebSocket

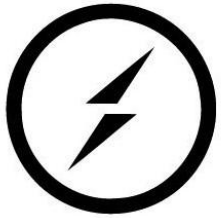
- Communication protocol used to send/receive data on the Internet
- Like HTTP, but on steroids… WebSockets are wa more efficient
- Persistent 2-way connection between <--> server
- Easy to build real-time applications:
  - Chat & Conferencing
  - Notifications
  - Online games
  - Financial trading
  - Live maps
  - …

Drawbacks

- Poor browser supports
- More complex handling both on client and server side, e.g. handling reconnection
- Eat massive memory to maintain a lots of connections
  - Well-designed client side polling sometimes costs lower pressure on the server depending on the actual business



Socket.IO



socket.io

- NodeJS module for event-based, bidirectional communication
- Encapsulates WebSocket and eliminates low-level details
- (near) real-time communication
- Cross-Platform support, automatically select the best approach
- **Allow binary streaming (important for video/audio)**
- Two components:
  - Server side module (NodeJS)
  - Client side script (JavaScript)

Socket.IO (server)

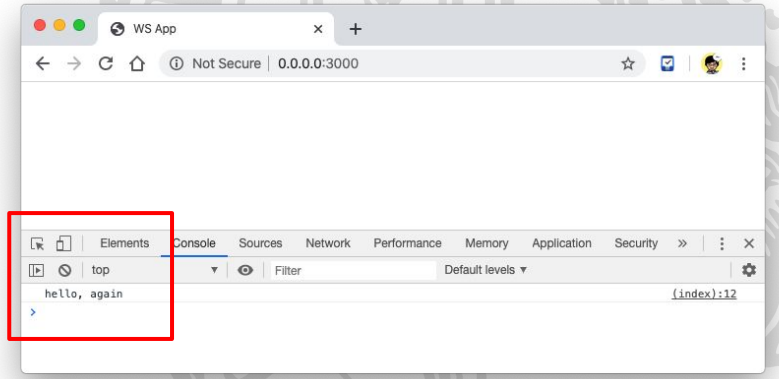
04-ws-app/index.js

```
var app = require('express')();
var http = require('http').createServer(app);
var io = require('socket.io')(http);
app.get('/', function(req, res) {
 res.sendFile(__dirname + '/index.html');
});
io.on('connection', function(socket) {
 socket.on('from-client', function(msg) {
   io.emit('from-server', msg + ', again');
 });
});
https.listen(3000);
```

Socket.IO (client)

04-ws-app/index.html

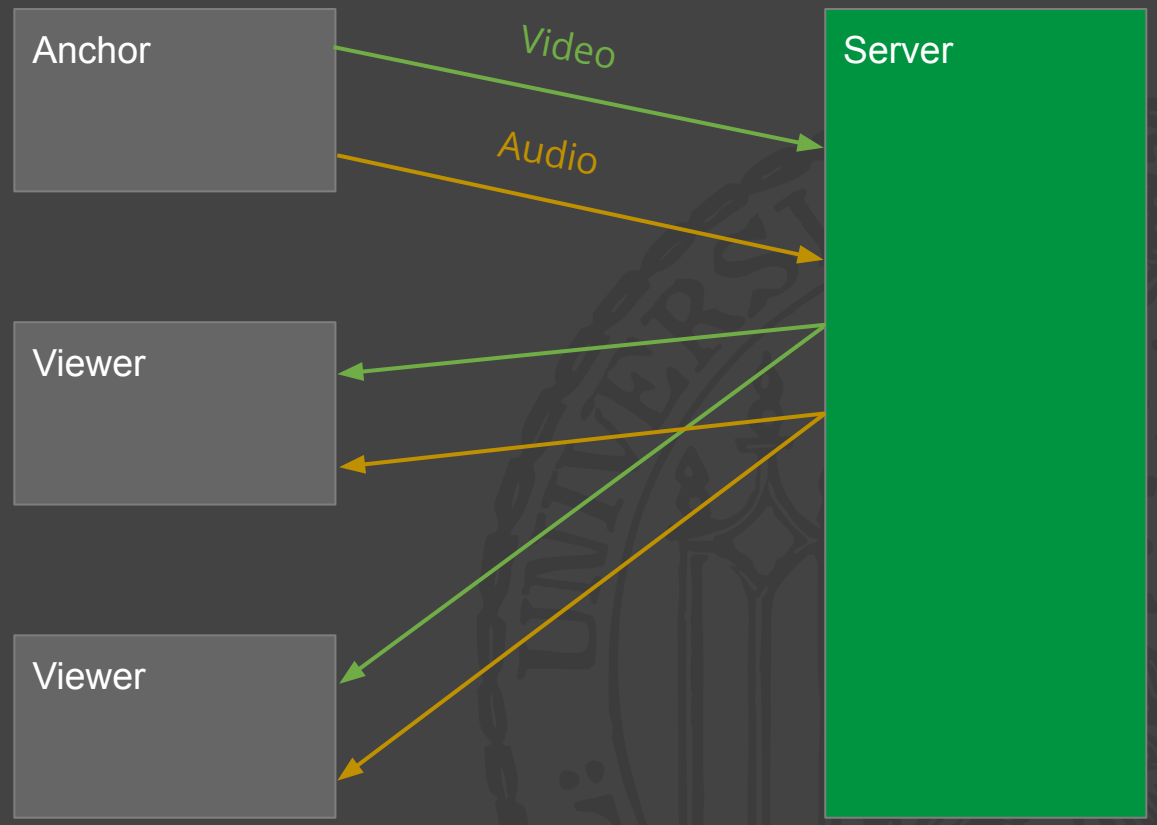
```
<script>
let socket = io()
socket.emit('from-client', 'hello')
socket.on('from-server', (data) => {
   console.log(data)// response 'hello, again'
})
</script>
```



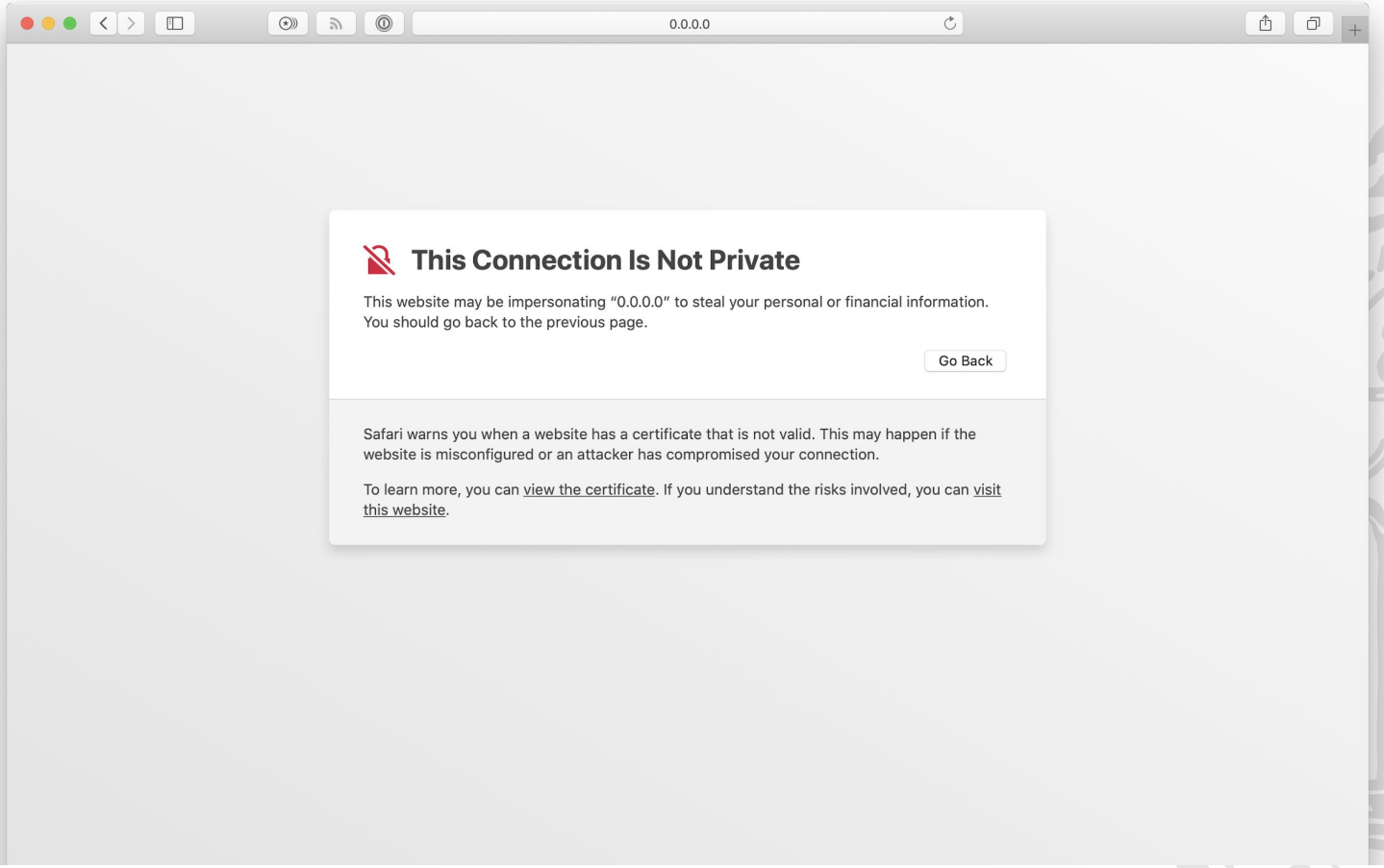
Code Alone: Twitch MIMUC over WS

- Use MediaDevices API and Socket.IO to implement a naive Twitch server :)

- Basic idea:
  - ***Anchor*** sends its video (a series of images) and audio via WebSocket to the server
  - Server replicates the video and audio then broadcasts (*push*) to ***viewers***



Issue: The Connection is Not Private



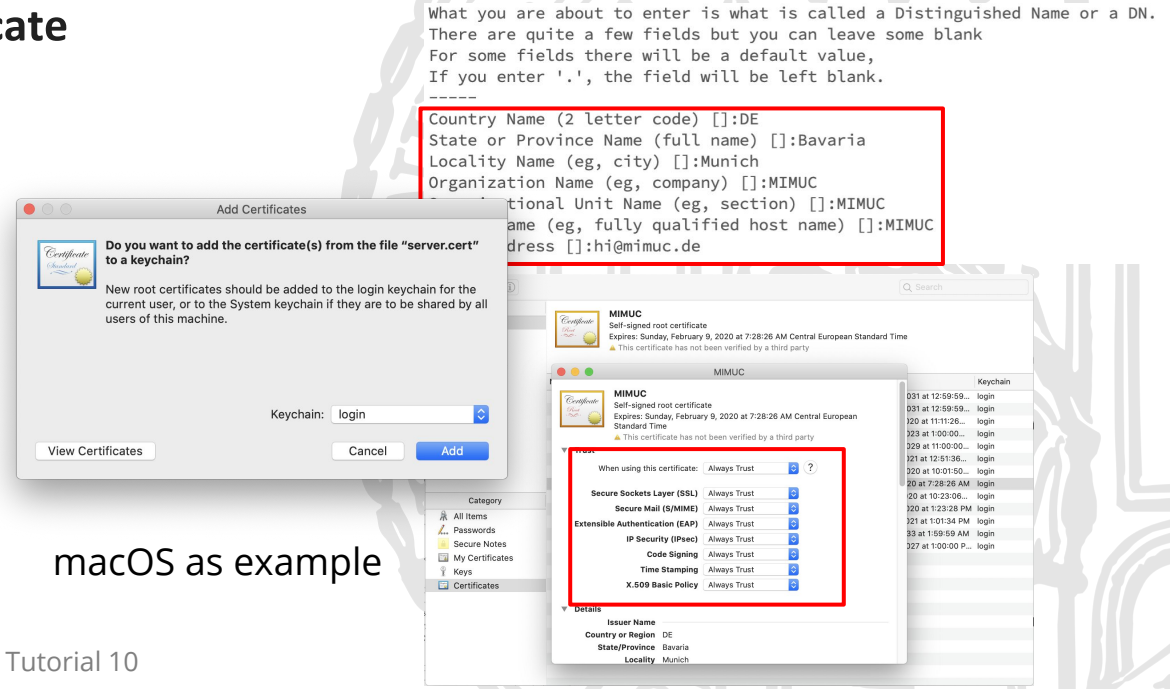
TIP: Resolving HTTPS locally

- Media Devices API **is only allowed in file:// or HTTPS environment**, which means you must setup your express server to support HTTPS, this is usually done by server side proxy, e.g. NGINX. A quick solution:
- **Step 1: Generate a self-signed HTTPS certificate, or use our provided certificate (see Github repo)**

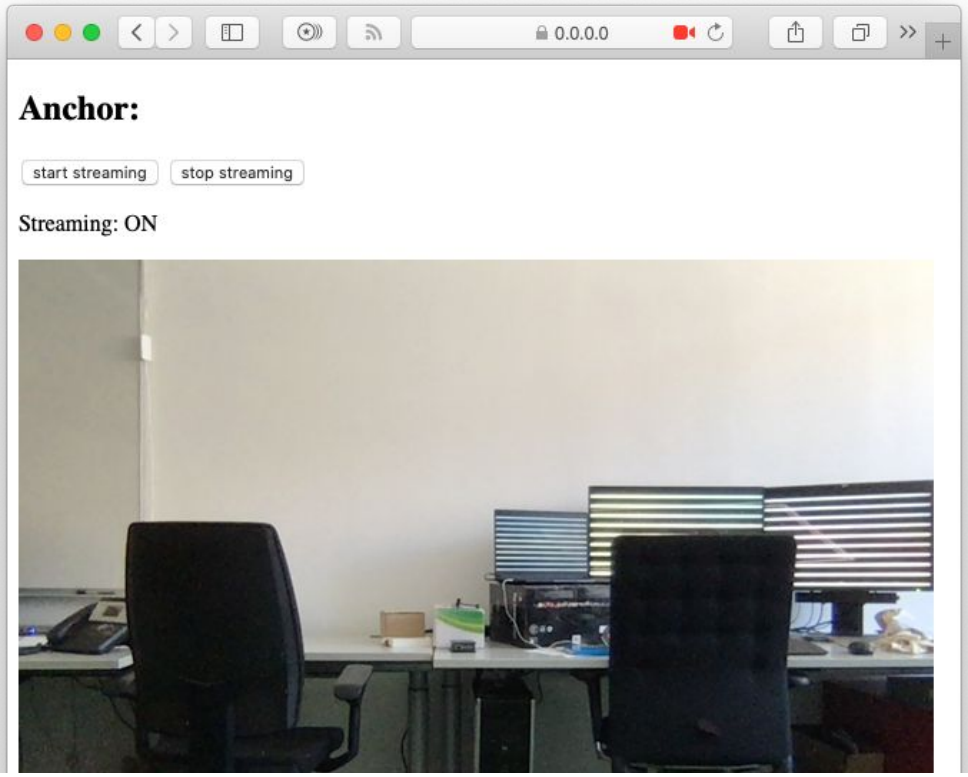
```
openssl req -nodes -new -x509 -keyout server.key -out server.cert
```

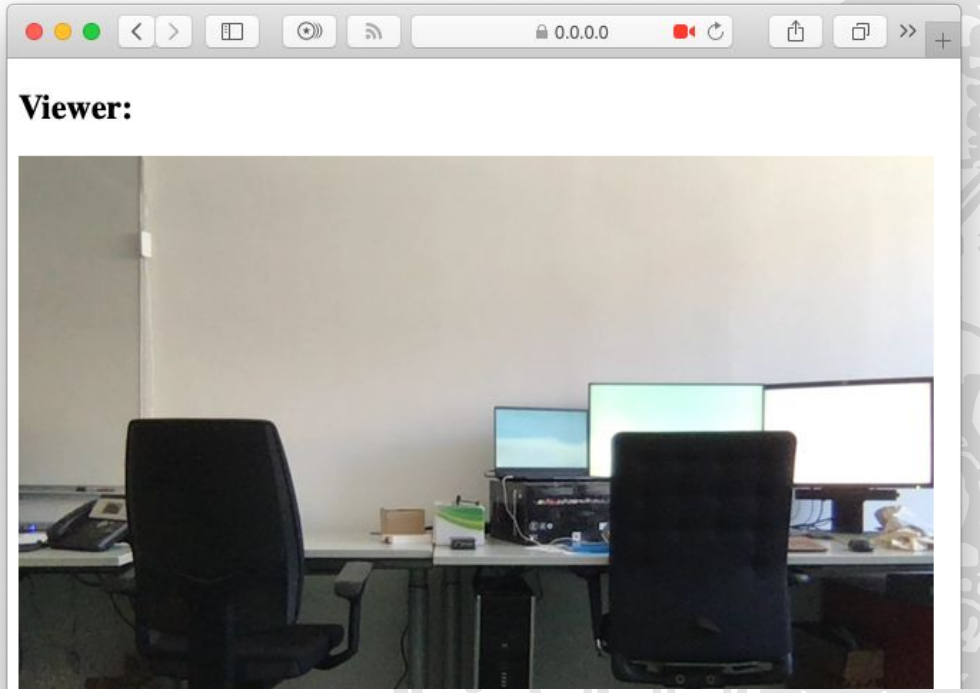
- **Step 2: Add .cert file to your system as a trusted certificate**
- **Step 3: In your express server, use https:**

```
var https = require('https').createServer({
 key: fs.readFileSync('server.key'),
 cert: fs.readFileSync('server.cert')
}, app);
var io = require('socket.io')(https);
…
https.listen(port, function(){
 console.log('listening on *:' + port);
});
```



macOS as example


0.0.0.0
Anchor:
start streaming
stop streaming
Streaming: ON


0.0.0.0
Viewer:

Reminder: Register Exam

- Exam
  - **Date**: February 11th 2020, 12:00-2:00 PM
  - **Location**: LMU main building, Geschwister-Scholl-Platz 1, **Room M218**

- **Register yourself via Uni2Work before 2020-02-05 23:59:00**

Thanks!
What are your questions?