
Software Construction and User Interface (SE/ComS 319)

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EVENT-DRIVEN PROGRAMMING

Outline

- Event-Driven Programming (EDP):
 - Concepts
 - Event handling
 - Event-driven architecture
 - Asynchronous programming, etc.
 - Web UI and EDP with JavaScript (Node.js)
 - GUI and EDP with JavaFX

Event-Driven programming (1)

- A programming paradigm in which the flow of the program is determined by **events** such as:
 - User actions (mouse clicks, key presses)
 - Sensor outputs (mostly in embedded systems)
 - Messages from other programs/threads (device drivers)

Event-Driven programming (2)

- Event-driven programming
 - ... is the dominant paradigm used in **graphical user interfaces** and other applications
 - e.g. JavaScript web applications: performing actions in response to user input.
 - ... is used in **Human-computer interaction (HCI)**

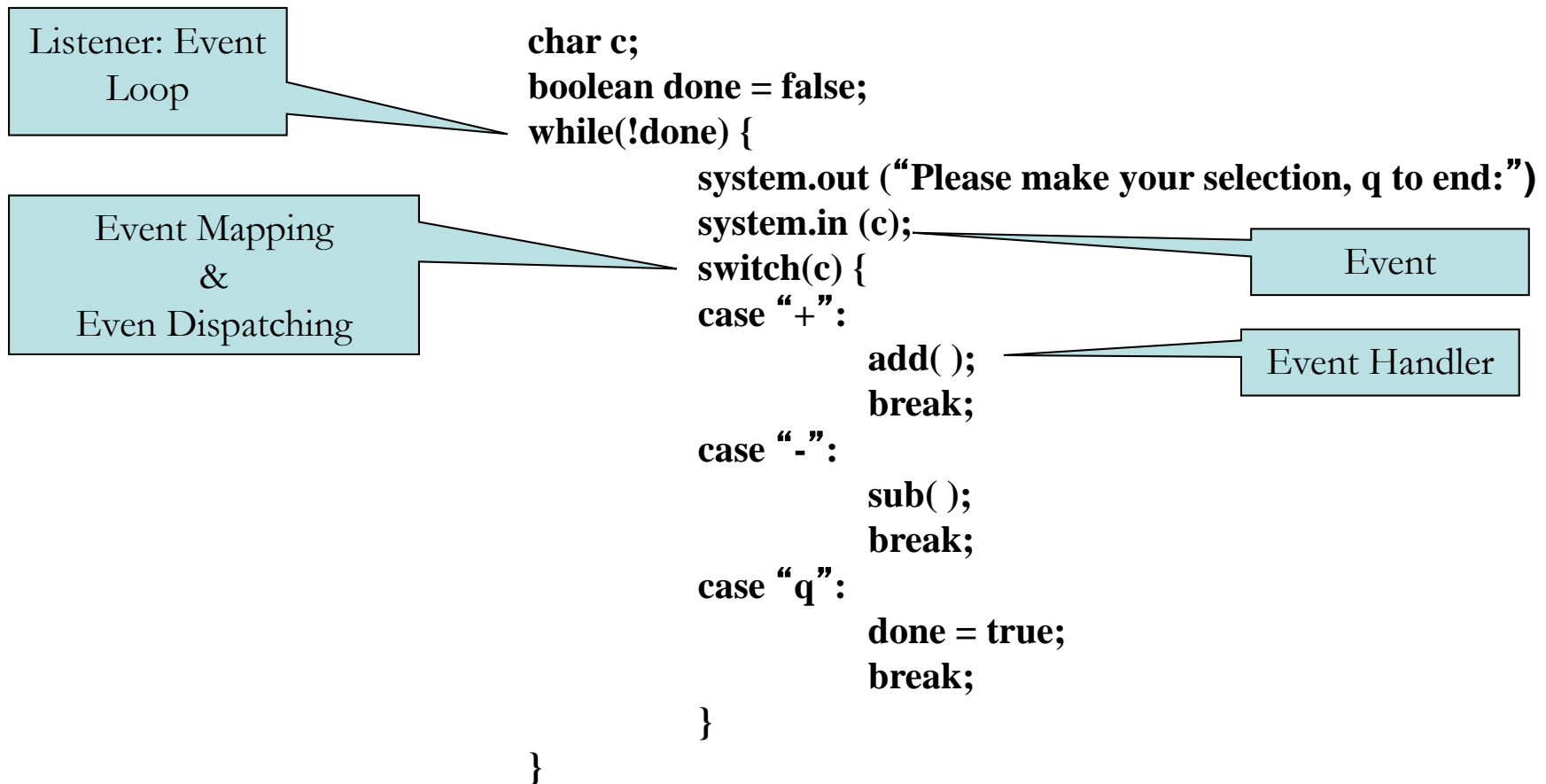
Human-computer interaction (HCI)

- HCI: Interactive computing systems for human use
 - CLI: command line interface (with keyboard)
 - **GUI: graphical user interface (mouse)**
 - NUI: natural user interface with Audio/Video (Kinect)
- A main HCI Component: **Interaction**
 - User interaction
 - Event
 - Event Handling
 - Output
- A **GOOD GUI** allows users to perform interactive tasks easily:
 - What you see is what you get

Event-Driven programming (2)

- Application waits (idles) after initialization until the user generates an event through an input device (keyboard, mouse, ...).
- The OS dispatches the event to the application who owns the active window.
- The corresponding event handler(s) of the application is invoked to process the event.

Event-Driven programming (2)



Event-Driven programming (4)

1. Event generators: GUI components (e.g. buttons, menus, ...)
2. Events/Messages: e.g. `MouseClicked`, ...
3. Event loop (Listener) : an infinite loop constantly waits for events.
4. Event mapping / Event registration: inform event dispatcher which event an event handler is for.
5. Event dispatcher: dispatch events to the corresponding event handlers.
6. Event handlers: methods for processing events. E.g. `OnMouseClicked()`, ...

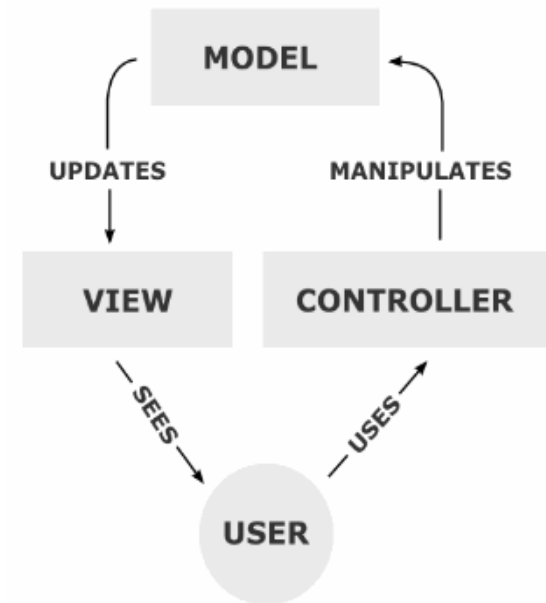
Event-driven programming (5)

- Concepts
- Event-driven programming with
 - JavaScript (Node.js)
 - JavaFX (Java)

EVENT-DRIVEN PROGRAMMING WEB USER INTERFACES

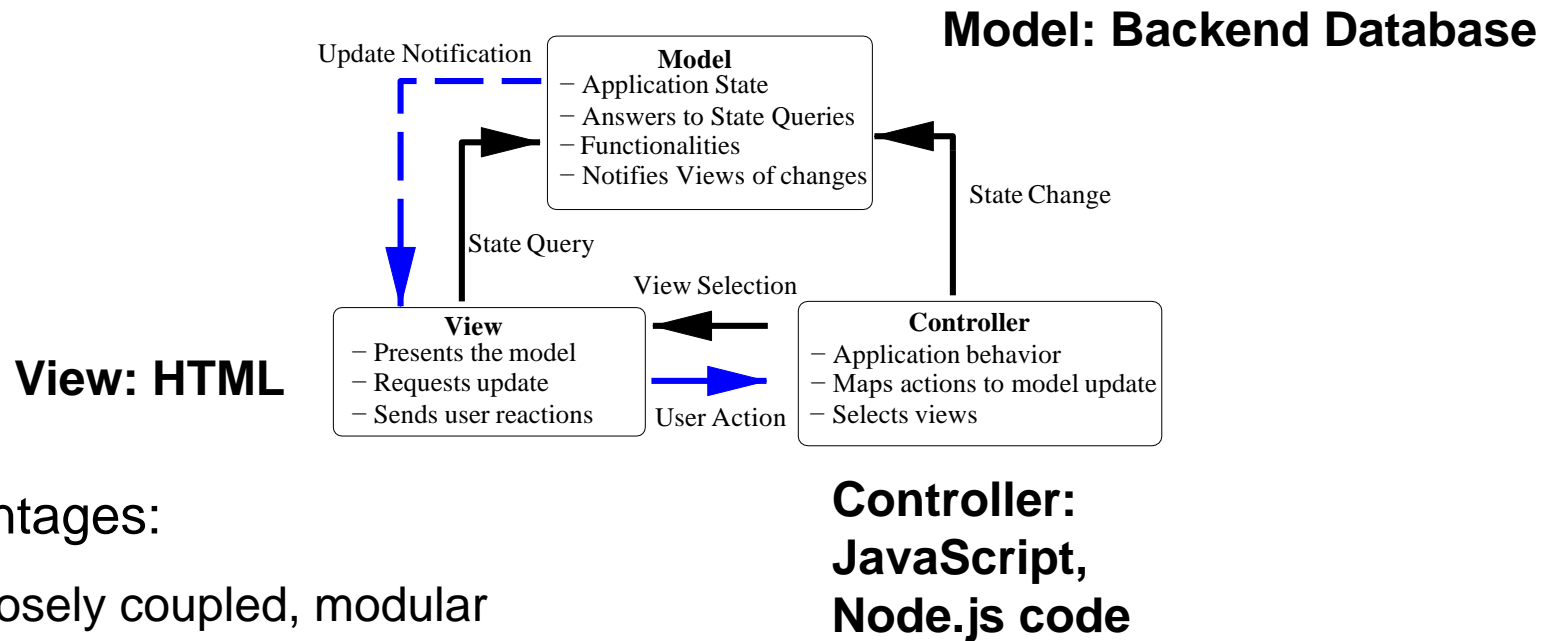
Event-Driven Programming – Web UI

- **MVC (Model – View – Controller) in Web UI:**
 - **View:** Browser presentation (HTML)
 - **Model:** Data (Backend Database or (simple) embedded)
 - **Controller:**
 - Client scripts/programs, e.g. JavaScript
 - Server scripts/programs, e.g. Node.js



MVC

- Model-View-Controller architecture:

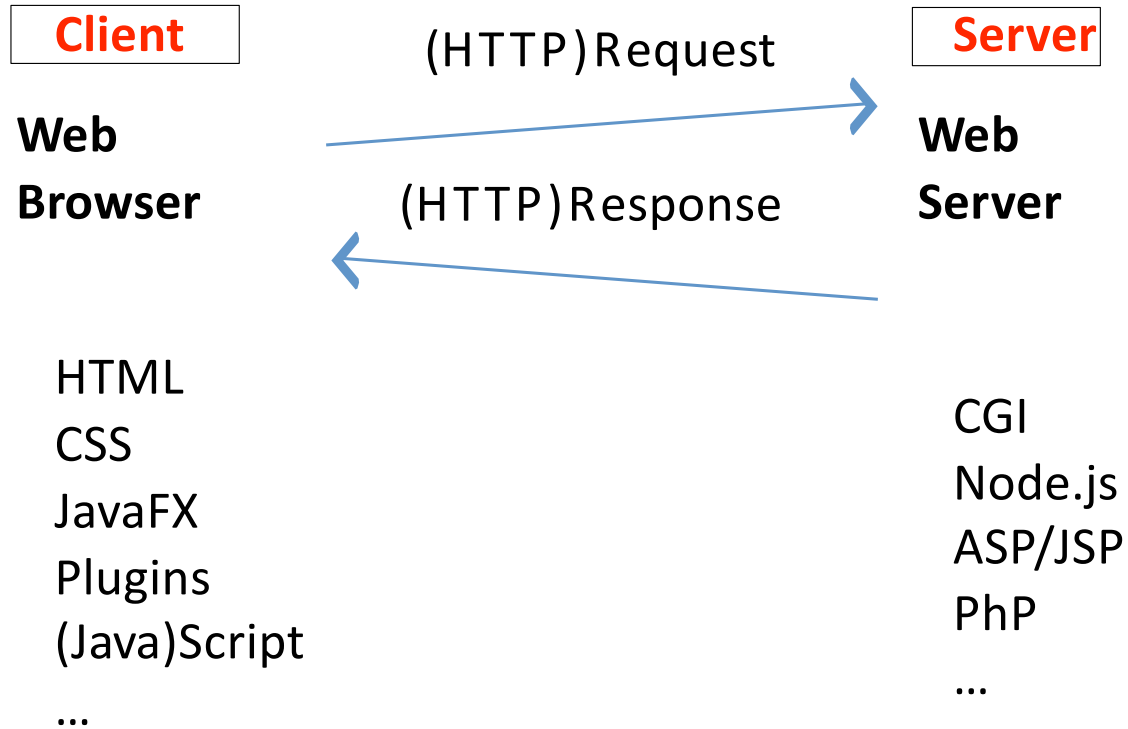


- Advantages:
 - Loosely coupled, modular
 - Model with different views
 - Controller decides when/how to update the model and/or the view
 - Model can change the view

Client/Server programming

- Use **client-side** programming for
 - Validating user input
 - Prompting users for confirmation, presenting quick information
 - Calculations on the client side
 - Preparing user-oriented presentation
 - Any function that does not require server-side information
- Use **server-side** programming for
 - Maintaining data across sessions, clients, applications

Web software: Client/Server (1)

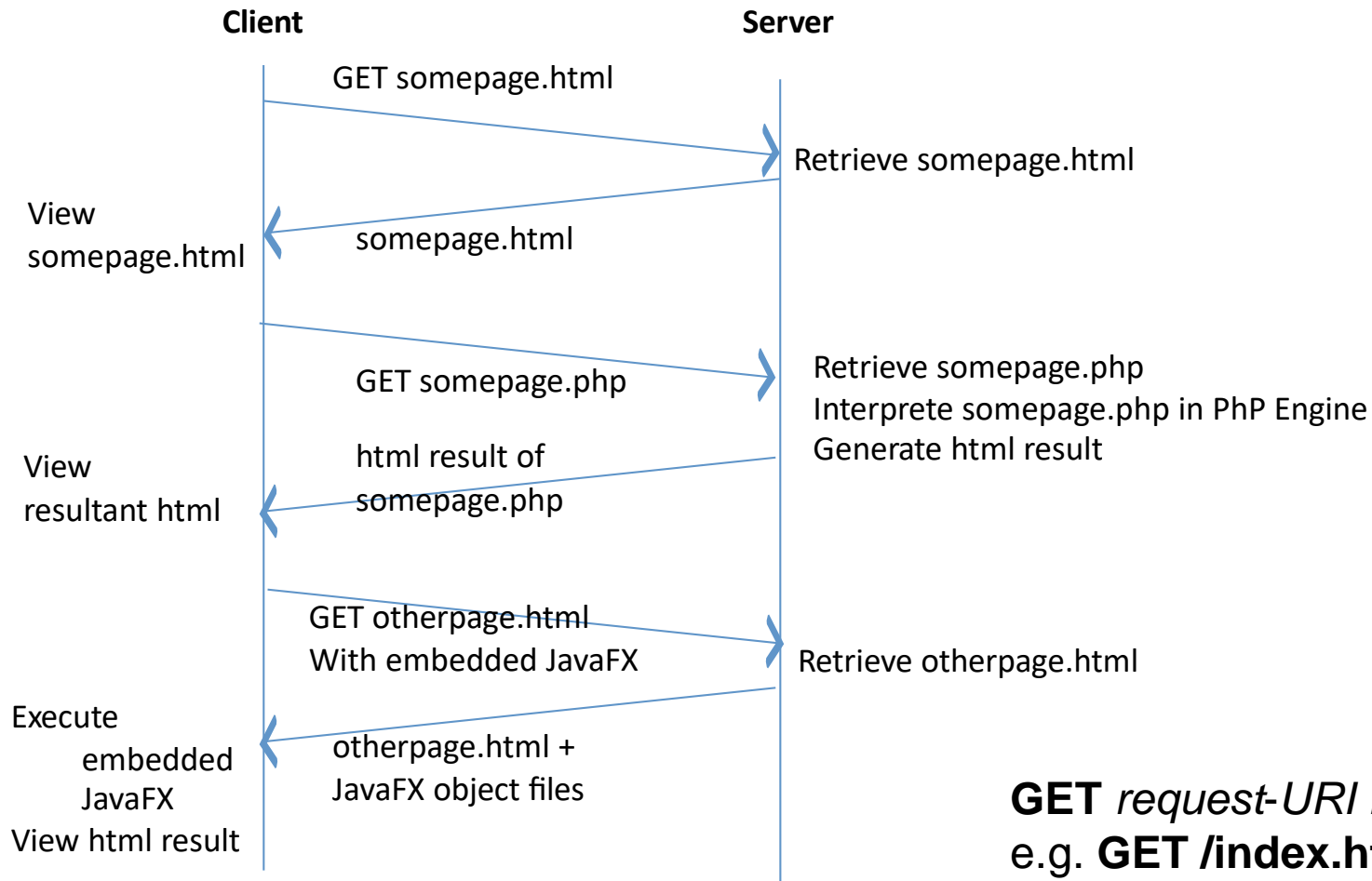


HTTP (Hypertext Transfer Protocol): HTTP is a client-server application-level protocol. It typically runs over a TCP/IP connection.

Web software: Client/Server (2)

- Web-client and Web-server communicates using HTTP protocol
 - Client can send a HTTP request: method “**get**” or “**post**”
 - Server can read a HTTP request and produce HTTP response
- Server side programs should be capable of reading HTTP request and producing HTTP response

Web software: Client/Server (3)



GET *request-URI HTTP-version*
e.g. **GET /index.html HTTP/1.0**

Common Gateway Interface (CGI) – Classic method

- Standard for the server to communicate with external applications
- Server receives a client (Http) request to access a CGI program
- Server creates a new process to execute the program
- Server passes client request data to the program
- Program executes, terminates, produces data (HTML page)
- Server sends back (Http response) the HTML page with result to the client

HTML – Example

```
<html>
<head></head>
<body>
<form action="<some-server side cgi program>" method="post">
First Name: <input type="text" name="fname"/>
Last Name: <input type="text" name="lname"/>
<input type="submit" value="Submit"/>
</form>
</body>
</html>
```

- Once the user clicks the submit button, the data provided in the form fields are “submitted” to the server where it is processed by a CGI program!

HTTP Request/Response Message

- Message Header
 - Who is the requester/responder
 - Time of request/response
 - Protocol used ...
- Message Body
 - Actual message being exchanged

HTTP Request

GET /index.html HTTP/1.1

Host: http://www.se.iastate.edu

Accept-Language: en

User-Agent: Mozilla/8.0

Query-String: ...

HTTP Response

HTTP/1.1 200 OK

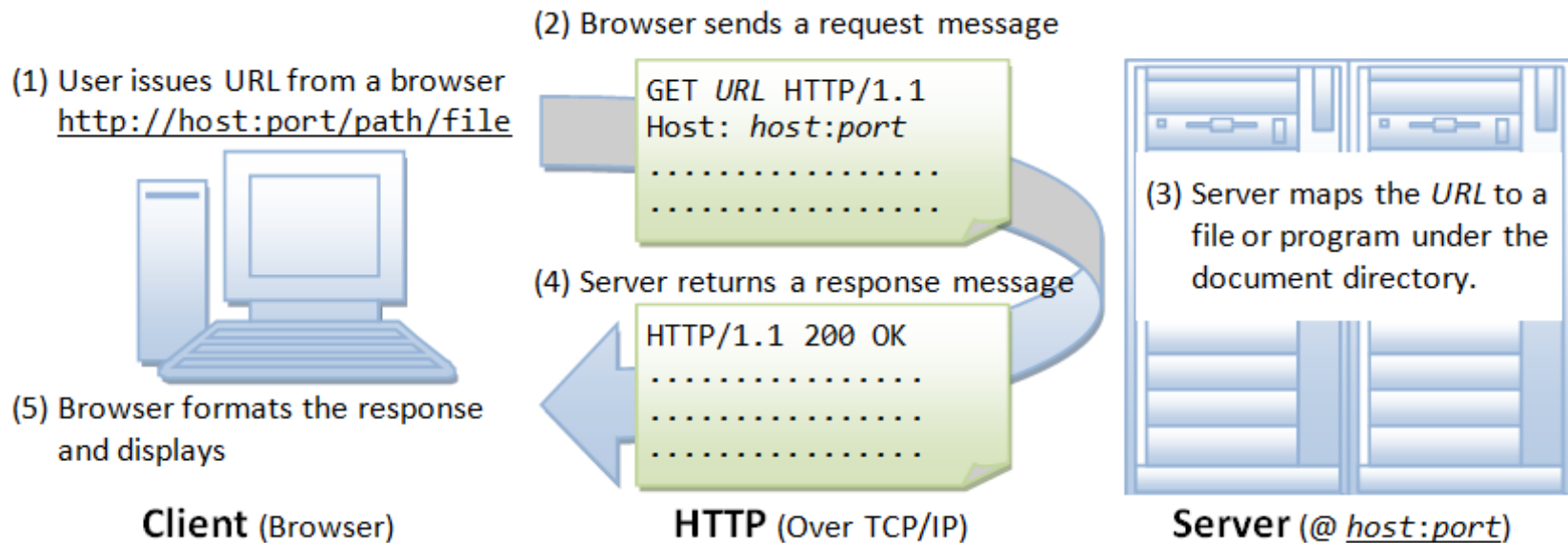
Date: Sat, 27 Oct 2007 16:00:00 GMT

Server: Apache

Content-Type: text/html

- Response Codes:
 - 200s: good request/response
 - 300s: redirection as the requested resource is not available
 - 400s: bad request leading to failure to respond
 - 500s: server failure

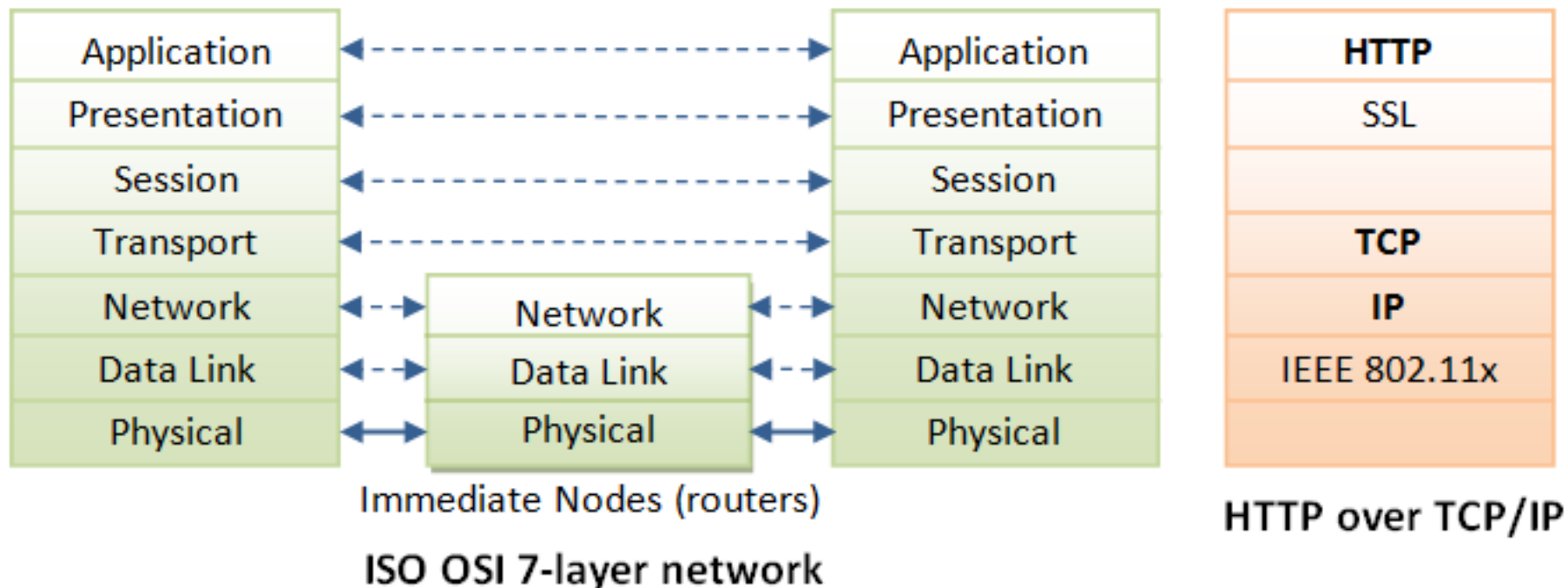
Web software: Client/Server



Source: https://www.ntu.edu.sg/home/ehchua/programming/webprogramming/HTTP_Basics.html

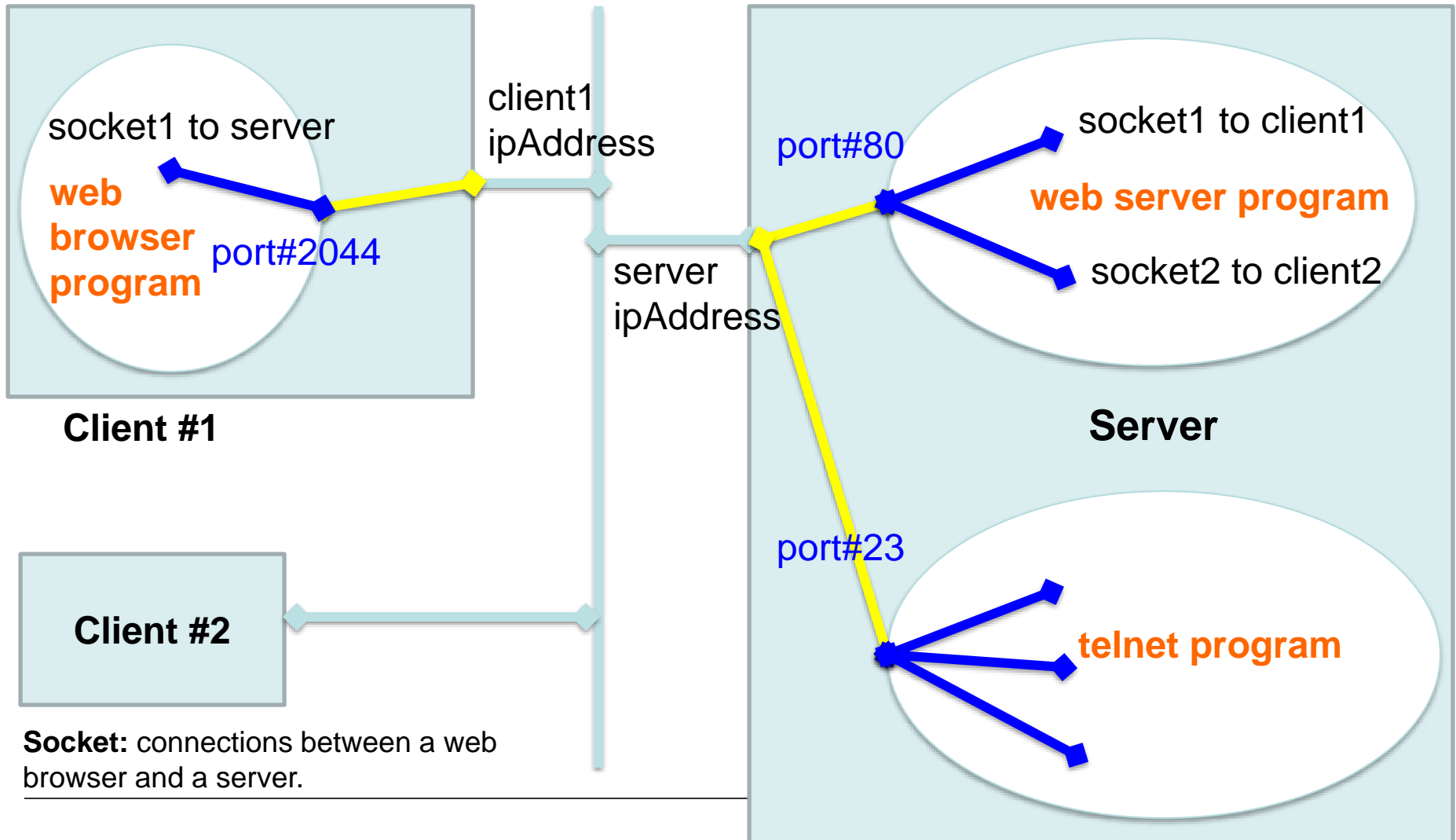
- **GET:** The GET method is used to retrieve information from the given server using a given URI.
 - Requests using GET should only retrieve data and should have no other effect on the data.

Client/Server: HTTP over TCP/IP



Source: https://www.ntu.edu.sg/home/ehchua/programming/webprogramming/HTTP_Basics.html

Web software: Client/Server – Connections



Client-Side Dynamics (1)

- HTML + Javascript
- Html elements: **forms**
- Html style elements: fonts, headings, breaks
- CSS: uniformly manipulate styles
- JavaScript:
 - manipulate styles (CSS)
 - manipulate html elements
 - validate user data
 - communicate with the server-side programs
- In HTML: `<input id="clk" type="button" value="Click" onclick="clkF()"/>`
- In Javascript file: `function clkF() { alert("Hello"); }`

Client-Side Dynamics (2)

- Html elements: **View**
- CSS: **Model**
- Javascript: **Controller**
- CSS: A simple mechanism for adding style to Web documents.
 - Look & feel of Webpages
 - Layouts, fonts, text, image size, location
 - Objective: Uniform update
- Javascript as a client side event-driven programming
 - Client-side computations
 - Form validation + warnings
 - Dynamic views

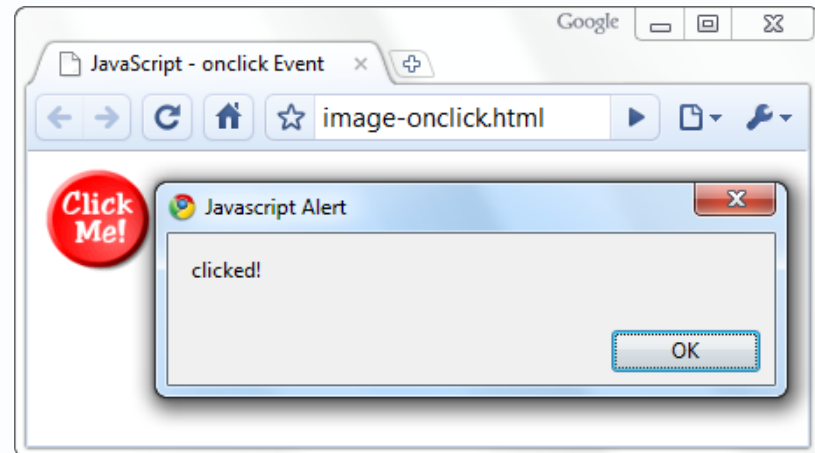
How to add JavaScript to html file?

- Include in html file:
 - `<script> your javascript code goes in here </script>`
- Can also include from a separate file:
 - `<script src="./01_example.js"></script>`
- Can include from a remote web site:
 - `<script src="http://.../a.js"></script>`

JavaScript Event Handler – Example

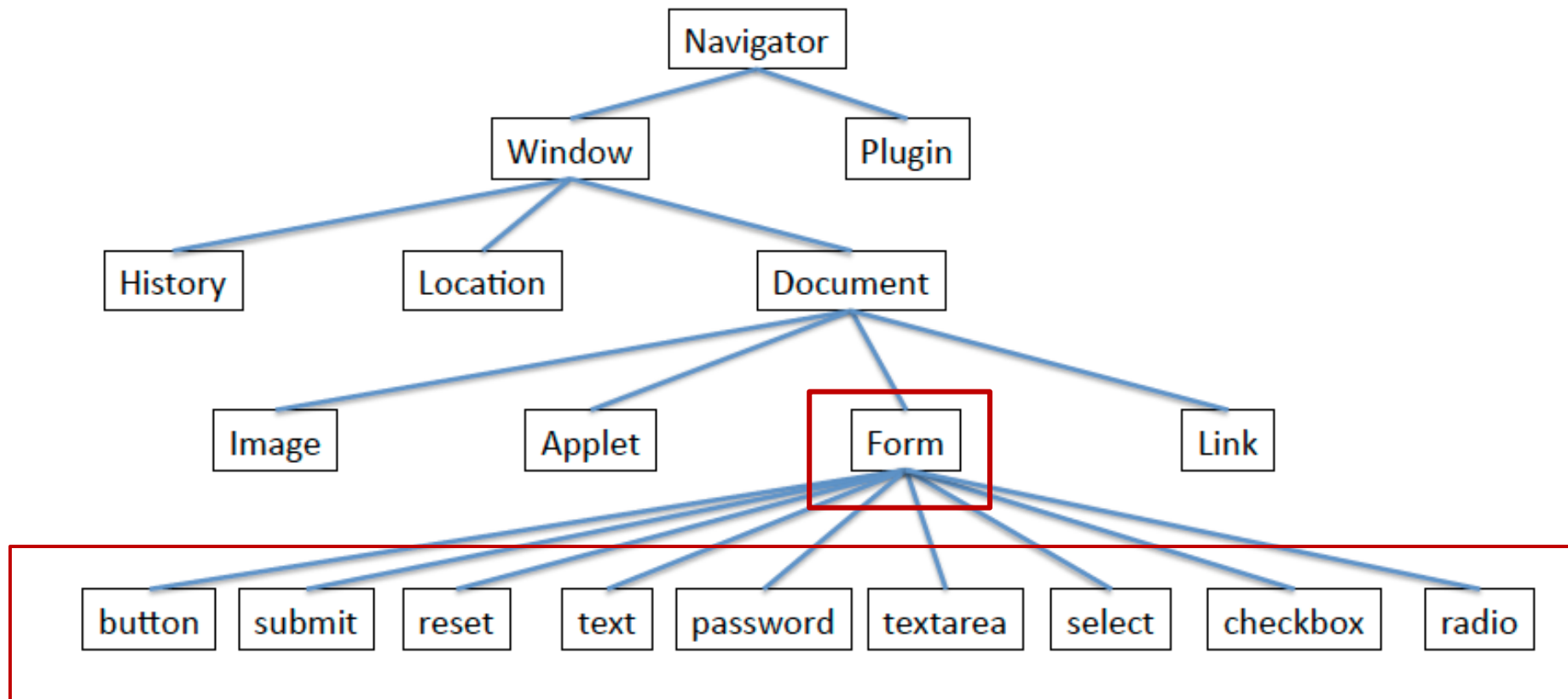
```
<html>
<head>
<script type="text/javascript">
  function test (message) {
    alert(message);
  }
</script>
</head>

<body>
  
</body>
</html>
```



Using **onclick**, we attach **event handlers**.

JavaScript accessibility hierarchy



NODE.JS

Event-driven programming – Node.js

- Open-source, cross-platform **JavaScript** run-time environment that executes JavaScript code **server-side**
 - Historically JavaScript used for client-side programming
- "JavaScript everywhere" paradigm (popular)
 - Unifying web application development
 - Same language for server side and client side scripts.



A JavaScript runtime environment running Google Chrome's V8 engine

Goal is to provide an easy way to build scalable network programs

Why Node.js?

- Non Blocking I/O
- V8 Javascript Engine
 - V8 is Google's open source high-performance JavaScript engine, written in C++ and used in Node.js
- Single Thread with Event Loop
- 40,025 modules: JavaScript libraries you can include in your project
- Different platforms: Windows, Linux, Mac,...
- 1 Language for Frontend and Backend
 - Core in C++ on top of V8
 - Rest of it in javascript
- Active community

Event-driven programming – Node.js

- Event-driven architecture
 - Asynchronous I/O
 - Scalability with many input/output operations
 - Real-time Web applications
 - e.g., real-time communication programs, browser games and data streaming, etc.
- Node.js functions are non-blocking
 - Commands execute concurrently or even in parallel (unlike PHP that commands execute only after previous commands finish)
 - Node.js uses callbacks to signal completion or failure

Asynchronous programming – Node.js

- Node.js uses asynchronous programming (runs single-threaded, **non-blocking**) → very memory efficient
- Handling a file request:
 - In PHP/ASP.net:
 1. Sends the task to the computer's file system.
 2. Waits while the file system opens and reads the file.
 3. Returns the content to the client.
 4. Ready to handle the next request.
 - In Node.js:
 1. Sends the task to the computer's file system.
 2. Ready to handle the next request.
 3. When the file system has opened and read the file, the server returns the content to the client.

Blocking vs. non-blocking: PHP vs. Node.js

- PHP:

```
<?php
$result = mysql_query('SELECT * FROM ...');
while($r = mysql_fetch_array($result)){
    // Do something
}
```

```
// Wait for query processing to finish...
?>
```

- Node.js:

```
<script type="text/javascript">
mysql.query('SELECT * FROM ...', function (err, result, fields){
    // Do something
});
```

```
// Don't wait, just continue executing
</script>
```

To select data from a table in MySQL, use the "SELECT" statement

Error handler

Callback!

The third parameter of the callback function is an array containing information about each field in the result object

Blocking vs. non-blocking

- **Blocking:**

- Read data from file `var data = fs.readFileSync("test.txt");`
- Show data `console.log(data);`
- Do other tasks `console.log("Do other tasks");`

- **Non-blocking:**

- Read data from file
 - When read data completed, show data!



Callback!

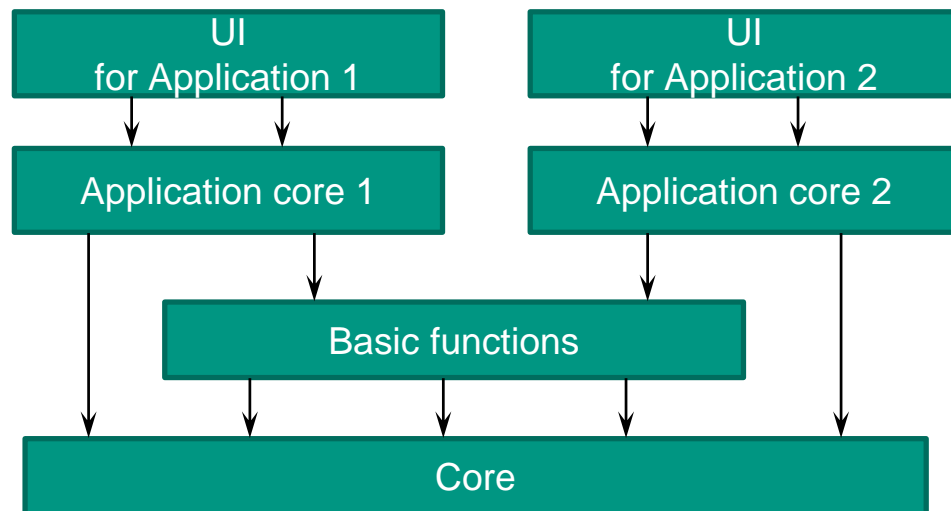
- Do other tasks `fs.readFile("test.txt", function(err, data) {
 console.log(data);
});`

Event-driven programming – When to use Node.js?

- Creation of Web servers and networking tools
 - Ideal for applications that serve a lot of requests but don't use/need lots of computational power per request
- Using JavaScript and a collection of **modules** that handle various core functionality such as:
 - File system I/O, networking (DNS, HTTP, TCP, TLS/SSL, or UDP), binary data (buffers), cryptography functions, data streams, etc.
 - Modules use an API (**interfaces**) designed to **reduce the complexity** of writing server applications

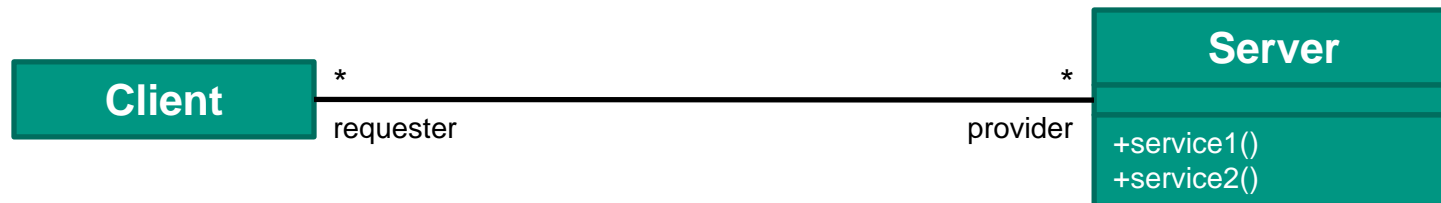
Event-driven architecture (1)

- Architectural patterns (n-tier, client/server, ...) may be applied by the design and implementation of applications and systems
 - Transmit events among loosely coupled software components and services
- n-tier architecture (layered architecture, see section Architectural styles)
 - 4-tier:



2-tier architecture – Client/Server

- One or more servers provide services for other subsystems called clients.
- Each client invokes a function of the server which performs the desired service and returns the result.
 - The client must know the interface of the server.
 - Conversely, the server does not need to know the client's interface.
- An example of a 2-tier, distributed architecture:



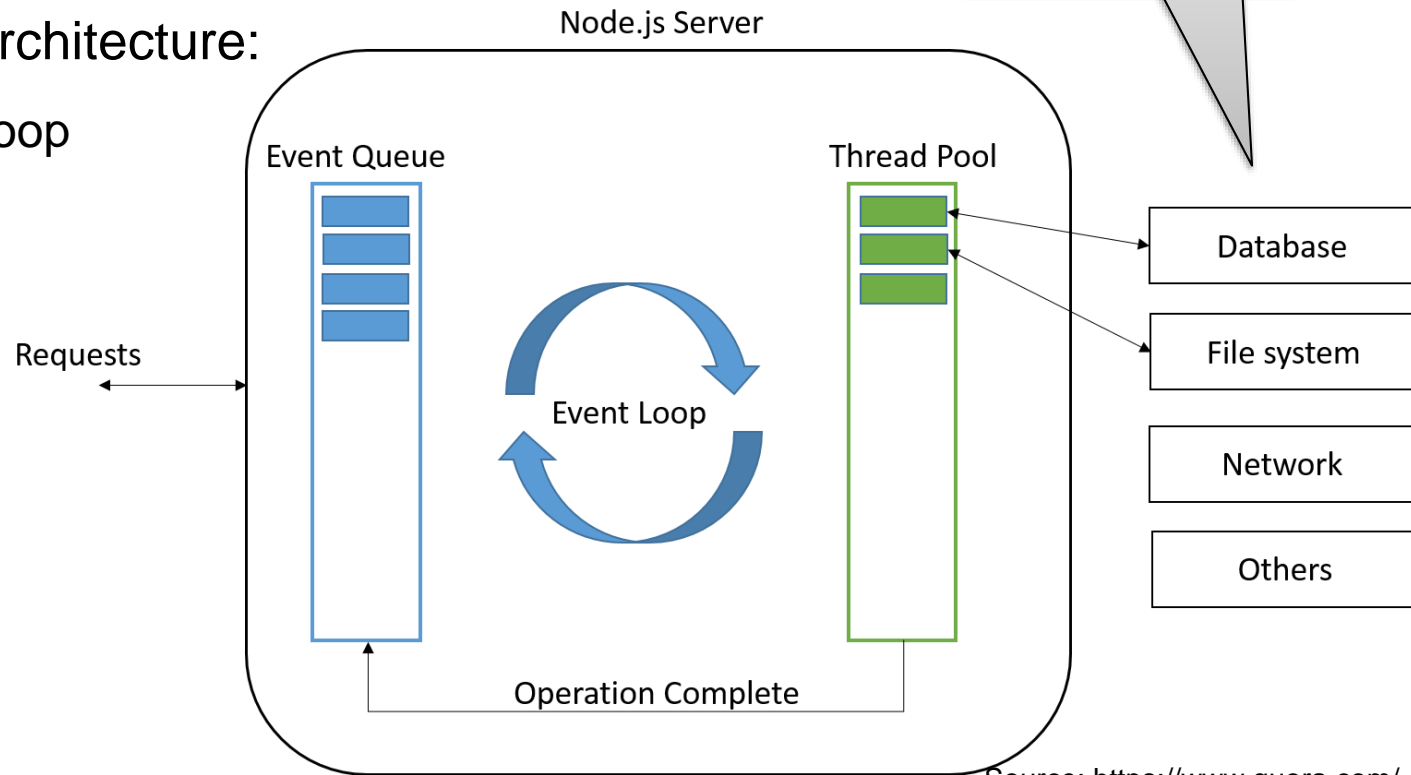
- Event-driven architecture: A **single thread** (server), of the event loop processes all the requests from clients (event queue)

Event-driven architecture (2)

- Event-driven architecture:
 - **Processing loop**
 - **Event queue**
 - **Call-back**

Event-driven architecture – Node.js

- Event-driven architecture:
 - Processing loop
 - Event queue
 - Call-back



Source: <https://www.quora.com/>

- Node.js Architecture: The event loop simply iterates over the event queue (a list of events) and callbacks of completed operations.

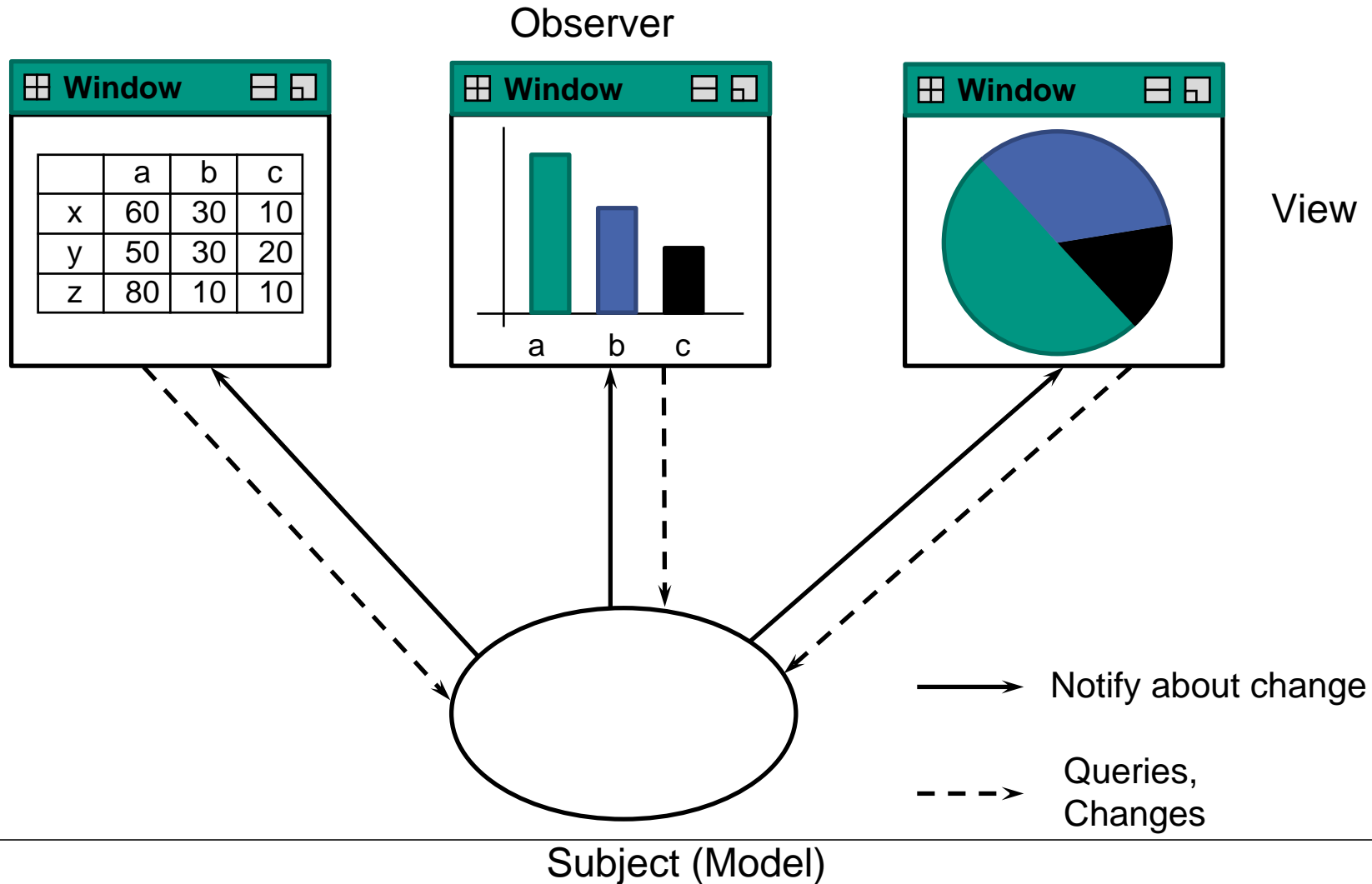
Event-driven architecture (3)

- Event-driven architecture can complement **service-oriented architecture (SOA)**
- Services can be activated by triggers fired on incoming events.
- SOA is an architecture style that assembles applications from (independent) services (see section Architectural styles)
- Services are considered as central elements of a company (keyword: services)
- Provide encapsulated functionality to other services and applications

Observer design pattern – Node.js

- A **single thread**, using non-blocking I/O calls
- ➔ **Observer** design pattern: sharing a single thread among all the requests
- Defines a **1-to-n** dependency between objects so that changing a state of an object causes all dependent objects to be **notified** and **updated automatically**.
- One to many relationship
- The many need to know changes in “one” immediately
- Synonyms (aka)
 - Dependence
 - Publisher-subscriber
 - Subject-observer

Observer example – MVC



Threading – Node.js

- A **single thread**, using non-blocking I/O calls
 - Support tens of thousands of concurrent connections **without** the **cost of thread context switching**
 - Building highly concurrent applications
 - A thread pool handles execution of parallel tasks
- Good for horizontal scaling (lots of request)!
- **Drawback** of the single-threaded approach: **No vertical** scaling by increasing the number of cores (not good for massive parallel computing)
 - Needs additional module: such as cluster, StrongLoop Process Manager, etc.
 - **Mitigation:** Developers can increase the default number of threads in the thread pool → OS distributes the threads across multiple cores

Thread-based vs. Event-based (Node.js)

| Threads | Asynchronous Event-driven |
|--|---|
| monitor (difficult to program) | event handler (using queue and then processes it) |
| scheduling (ready, running, waiting, ...) | event loop (only one thread, which repeatedly fetches an event) |
| exported functions (thread-safe) | event types accepted by event handler |
| returning from a procedure (using context switching) | dispatching a reply (no contention and no context switches) |
| executing a blocking procedure call | dispatching a message, awaiting a reply |
| waiting on condition variables | awaiting messages |

Conclusion:

- Use threads for performance critical applications (kernels)
- Use events for GUI and distributed systems

What can you do with Node.js?

- Node.js file contains tasks and executes them upon set of events
 - Generate dynamic content (even desktop programs in js)
 - Create, open and read, or delete files on the server
 - Gather and modify data in the database
 - Collect form data, etc.
- Availability of rich frameworks
 - Angular, Node, Backbone, Ember, etc.
- Ability to keep data in native JSON (JavaScript Object Notation, similar to XML) format in your database
- Very good supportive community
 - Linux Foundation, Google, PayPal, Microsoft, ...

Node.js – Libraries

standard lib

process.argv // command line arguments
console.log
setInterval(callback, time)
require(library)

fs

Readdir // reads the contents of a directory
readFile //read entire file
readFileSync
createReadStream //read in chunks

path

Extname // get the extension from a file path

Node.js – Example 'Hello World!'

```
var http = require('http');
```

include a module (library), use the require() function with the name of the module

```
//create a server object:
```

Use the createServer() method to create an HTTP server

```
http.createServer(function (req, res) {
```

Represents the request/response from/to the client

```
  res.write('Hello World!'); //write a response to the client
```

```
  res.end(); //end the response
```

```
}).listen(8080); //the server object listens on port 8080
```

Writes "Hello World!" if a web browser tries to access your computer on port 8080

Node.js – Example 'Hello World!' (2)

- Create a file named "app.js"

```
const http = require('http');

const hostname = '127.0.0.1';
const port = 3000;

const server = http.createServer((req, res) => {
  res.statusCode = 200;
  res.setHeader('Content-Type', 'text/plain');
  res.end('Hello World\n');
});

server.listen(port, hostname, () => {
  console.log(`Server running at http://${hostname}:${port}/`);
});
```

Source:
<https://nodejs.org/en/docs/guides/getting-started-guide/>

Using Existing modules

```
var fs = require('fs');    // include File System module
var path = require('path');
// typically an object or a function is returned.
```

```
var buf = fs.readdir(process.argv[2], // command line arguments
function(err, data) {
  for (i = 0; i < data.length; i++) {
    var s = path.extname(data[i]);
    if (s === "." + process.argv[3]) {
      console.log(data[i]);
    }
  }
} // end of for
} // end of callback function for readdir
```

Create your own modules – Example (1)

```
exports.myDateTime = function () {  
    return Date();  
};
```

Save the code above in a file called "myfirstmodule.js"

```
var http = require('http');  
var dt = require('./myfirstmodule');
```

Include and use the module in any of your Node.js files.

```
http.createServer(function (req, res) {  
    res.writeHead(200, {'Content-Type': 'text/html'});  
    res.write("The date and time are currently: " + dt.myDateTime());  
    res.end();  
}).listen(8080);
```

Create your own modules – Example (2)

// FILE myModule.js

```
module.exports = function (dir, ext, callback) {  
  var fs = require('fs');  
  var path = require('path');  
  var retValue =[];  
  fs.readdir(dir, function(err, data) {  
    if (err) return callback(err);  
    retValue = data.filter(function(filename) {  
      return path.extname(filename) === "." + ext;  
    });  
    callback(null, retValue);  
  }); // end of callback to readdir  
  
}; // end of function
```



USERS of this module will need to provide **dir**, **extension**, and **callback**

Create your own modules – Example (2)

Using the created module

```
var x = require('./mymodule');
```

```
// users need to provide dir, extension, callback
```

```
//
```

```
x(process.argv[2], process.argv[3], function(err, data)
```

```
{
```

```
  if (err) return console.error ("error:", err);
```

```
  data.forEach(function(file) { // for each array element
```

```
    console.log (file);
```

```
  });
```

```
} // end of callback function
```

```
); // end of call to x
```

Asynchronous I/O – Example

- **NO WAIT!** until read is complete:

```
var fs = require('fs');  
var buf = fs.readFile(process.argv[2],  
  function(err, data) { //CALLBACK  
    if (err) { return console.log(err); }  
    var sArray = data.toString().split("\n");  
    console.log(sArray.length-1);  
  } );
```

Include the File System module:
fs = require('fs');
fs.readFile(file, [encoding], [callback]);

fs.readFile() method is used to read files .

// NO WAIT! – DO THE NEXT INSTRUCTION RIGHT AWAY

Synchronous I/O – Example

Waits until i/o is done

EXAMPLE:

```
var fs = require('fs'); // node's modular code
```

```
var buf = fs.readFileSync(process.argv[2]);
```

```
//WAIT!
```

```
var sArray = buf.toString().split("\n");
```

```
console.log(sArray.length-1); // print number of lines
```


Standard callback pattern

Callback function will look like:

```
function (err, data) {  
    if (err) { // handle error }  
    else {  
        // do something with data  
    }  
});
```

This callback is **called once** when event happens (for example, i/o is complete)

Event handling – Event emitter pattern

// Instead of only completed event, many events may be fired.

// Handlers can be registered for each event.

```
var fs = require('fs');
```

```
var file = fs.createReadStream('./' + process.argv[2]);
```

readStream object fires events when opening and closing a file

```
file.on('error', function(err) {  
  console.log("Error:" + err);  
  throw err;  
});
```

createReadStream fires **error**, **data**, and **end** events

```
file.on('data', function(data) {  
  console.log("Data: " + data);  
});
```

Using **on** function, we attach **event handlers**.

```
file.on('end', function() {  
  console.log("finished reading all of data");  
});
```

Event emitter API

- **Event types (determined by emitter)**
 - error (special type)
 - data
 - end
- **API**
 - `.on` or `.addListener`
 - `.once` (will be called at most once)
 - `.removeEventListener`
 - `.removeAllEventListeners`

Creating an event emitter – Example

// file named myEmitter.js

var util = require('util'); // step 1

Util module provides access to some utility functions.

var EventEmitter = require('events').EventEmitter; // step 2

var Ticker = function() {

var self = this;

setInterval (function() {

self.emit('tick'); // step 3

}, 1000) ;

};

With "events" you can create-, fire-, and listen for- your own events.

util.inherits (Ticker, EventEmitter); // step 4

Inherits methods from one function into another

module.exports = Ticker;

Creating an event emitter – Example (using Ticker)

```
// testingTicker
```

```
var Ticker = require("./myEmitter");
```

```
var ticker = new Ticker();
```

```
ticker.on ('tick', function() { // handler for 'tick' event  
    console.log("Tick");  
});
```

Servers

Simple servers

```
require('net')
```

```
createServer()
```

```
listen(port#)
```

```
'error'
```

```
'connection'
```

```
'data'
```

```
'close'
```

HTTP servers

```
require('http')
```

```
createServer()
```

```
listen(port#)
```

```
'request'
```

```
req.on 'data'
```

- net module provides an asynchronous network API for creating stream-based TCP servers

Use Node.js for ...

- Chat/Messaging
 - Real-time Applications
 - Intelligent Proxies
 - High Concurrency Applications
 - Communication Hubs
 - Coordinators
 -
- Web application
 - Websocket server
 - Ad server
 - Proxy server
 - Streaming server
 - Fast file upload client
 - Any Real-time data apps
 - Anything with high I/O
 -

Literature – Node.js

- <https://nodejs.org/en/>
- <https://www.w3schools.com/nodejs/default.asp>
- <https://www.tutorialspoint.com/nodejs/index.htm>
- <https://npmjs.org/>

FRAMEWORKS AND API

Libraries and frameworks for Node.js & JavaScript (1)

- Chrome DevTools
 - Debugging JavaScript
 - Performance analysis
 - Chromium project: open-source projects behind the Google Chrome browser and Google Chrome OS
- **NPM** is a package manager for Node.js packages, or modules

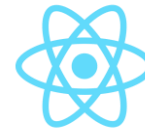


- npm is the package manager for JavaScript
- world's largest software registry:

<https://www.npmjs.com/>

Libraries and frameworks for Node.js & JavaScript (2)

- Libraries:
 - **React.js:** JavaScript library for building user interfaces by Facebook
 - **Angular/Angular.js:** TypeScript-based Javascript framework by Google
 - **Vue.js:** rapidly growing JS frameworks
- Develop across all platforms
 - ➔ Progressive Web App (PWA)
- Turn websites into native phone and desktop applications



Next Step: Progressive Web App – PWA (1)

- **PWAs are web applications** that can appear to the user like **traditional applications** or **native mobile applications!**
 - Combines features offered by browsers with the benefits of a mobile experience
 - Let users upgrade web apps to progressive web applications in their native OS
- Native Apps: coded in a programming language like Java
- Traditional Web Apps: coded in standard HTML, CSS, and JavaScript

Next Step: Progressive Web App – PWA (2)

- **PWAs:** visit in a browser tab, no install required!
 - Visit the site, add to home screen,
 - Go to home screen and open site, use the app!
 - Supported by Google Chrome and Mozilla Firefox

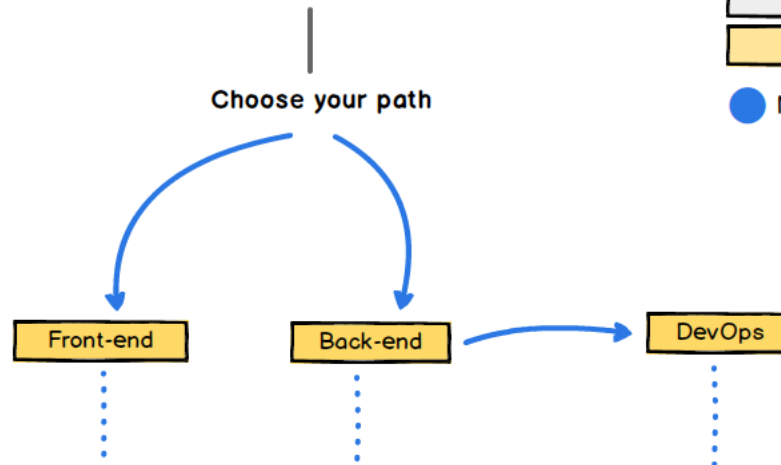


The 2018 Web Developer Roadmap (1)

Required for any path

| |
|--|
| Git - Version Control |
| SSH |
| HTTP/HTTPS and APIs |
| Basic Terminal Usage |
| Learn to Research |
| Data Structures & Algorithms |
| Character Encodings |
| Design Patterns |
| GitHub |
| Create a profile. Explore relevant open source projects. Make a habit of looking under the hood of projects you like. Create and contribute to open source projects. |

Web Developer in 2018

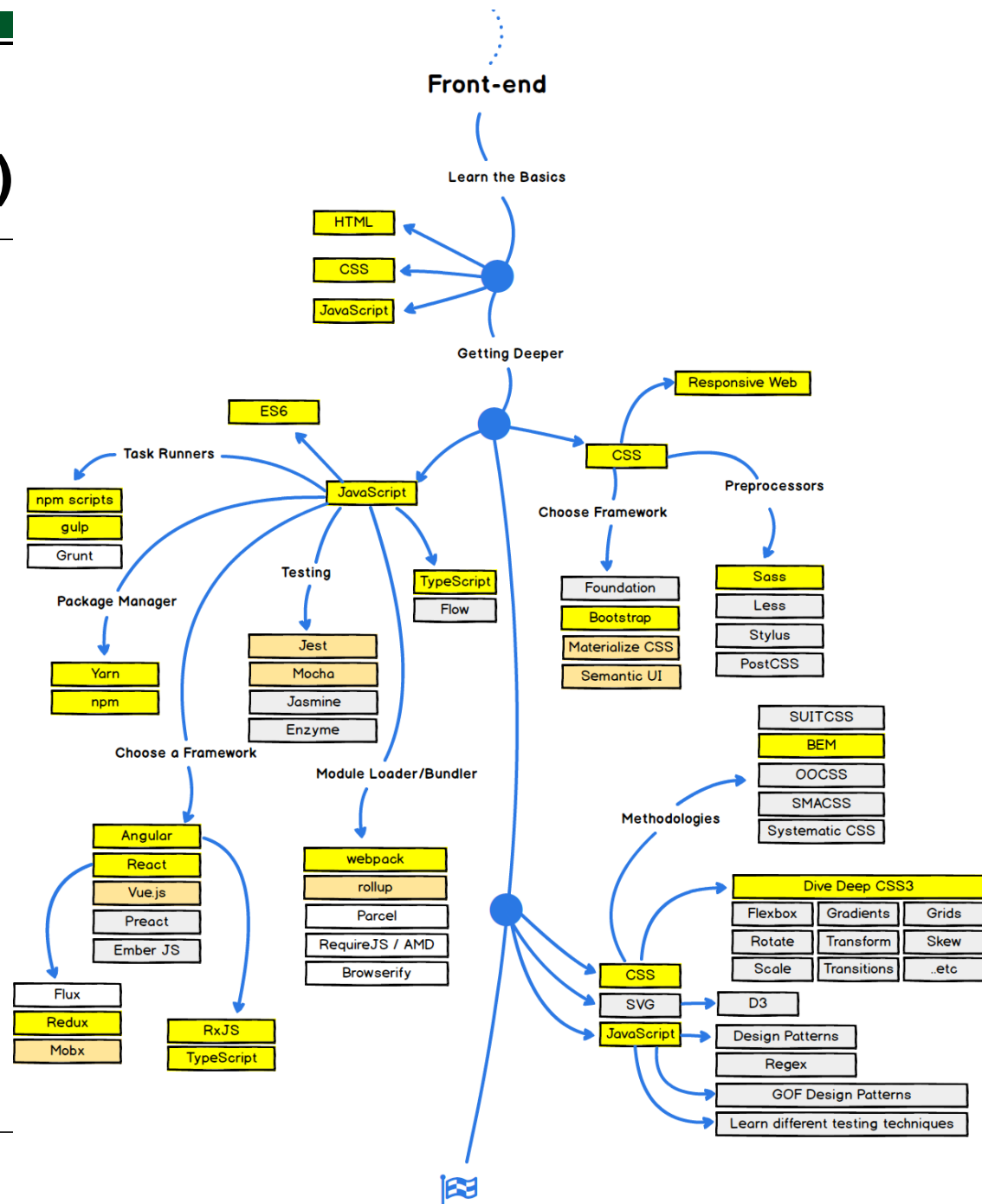


Legends

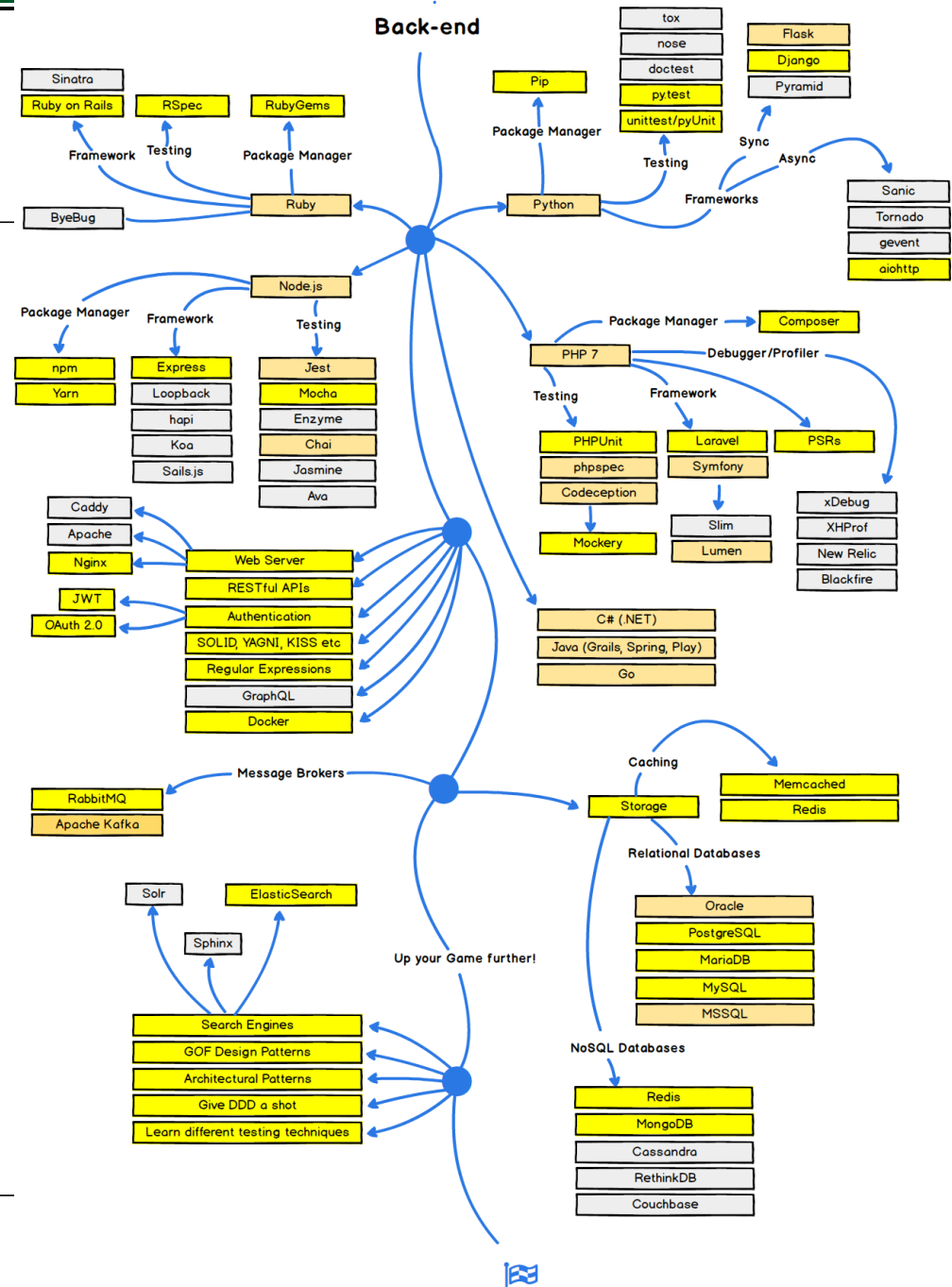
| |
|--------------------------|
| Personal Recommendation! |
| Possibilities |
| Pick any! |
| ● Now build something |

Source: <https://codeburst.io/the-2018-web-developer-roadmap-826b1b806e8d>

The 2018 Web Developer Roadmap (2)



The 2018 Web Developer Roadmap (3)



Laravel – The PHP Framework

- What is it?
 - A framework
- Why learn it?
 - Organize code into appropriate folders (modular development)
 - Use conventions for quick development + maintenance
 - Access libraries and utilities, authentication, etc.

Laravel – MVC Framework

1. Submit User Request

2. Route to appropriate Laravel Controller

Routing

Controller

3. Interact with Data Model

4. Controller invokes results View

View

Model

5. Render view in users browser



Database



Laravel – Main files and locations

./.env

./app/Http/routes.php

1 - routes

./app/Http/Controllers/Auth/AuthController.php

./app/Http/Controllers/Auth/PasswordController.php

./app/Http/Controllers/Controller.php

./app/Http/Controllers/MyController.php

2 -
controllers

./app/TestTable.php

./app/User.php

3 - model

./config/app.php

./config/database.php

./config/view.php

4 - config

./public/.htaccess

./public/index.php

./public/web.config

5 - website

./resources/views/errors/503.blade.php

./resources/views/welcome.blade.php

6 - views

./tests/ExampleTest.php

./tests/TestCase.php

7 - tests

Routes

Way to redirect the request (or URL) from the client.

In the below example, requests to home will return a welcome view.

```
<?php
Route::get('/', function () {
    return view('welcome');
});
```

1

```
...
Route::get('/myStuff', 'MyController@getTableData');
```

2

Controllers

1. This is where the main work takes place
2. It may make calls to the database
3. It may make calls to some processing modules
4. It may make calls to create some views
5. and then returns the results back to the client.

Controllers – Example

```
<?php
```

```
namespace App\Http\Controllers;
```

```
use Illuminate\Foundation\Bus\DispatchesJobs;
```

```
use Illuminate\Routing\Controller as BaseController;
```

```
use Illuminate\Foundation\Validation\ValidatesRequests;
```

```
use Illuminate\Foundation\Auth\Access\AuthorizesRequests;
```

```
class MyController extends BaseController
```

```
{  
    public function getTableData(){  
        echo json_encode(\App\testTable::all());  
    }  
}
```

Eloquent ORM – Object Relational Mapper

- Provides a simple ActiveRecord implementation for working with a database.
- Each database table has a corresponding "Model" which is used to interact with that table
 - Models data
 - Simple access to data

Model – Example

```
<?php

namespace App;

use Illuminate\Foundation\Auth\User as Authenticatable;

class TestTable extends Authenticatable
{
    protected $table = 'testTable';
    public $timestamps = false;
}
```


Configuration file (.env file) – Example

```
APP_ENV=local
APP_DEBUG=true
APP_KEY=2uUDtMdi5ldsgHNQjdHQAyUwRHgWfjmW
APP_URL=http://localhost
```

```
DB_HOST=127.0.0.1
DB_PORT=3306
DB_DATABASE=testSchema
DB_USERNAME=testuser
DB_PASSWORD=testuser
```

```
CACHE_DRIVER=file
SESSION_DRIVER=file
QUEUE_DRIVER=sync
```

```
REDIS_HOST=127.0.0.1
REDIS_PASSWORD=null
REDIS_PORT=6379
```

```
MAIL_DRIVER=smtp
MAIL_HOST=mailtrap.io
MAIL_PORT=2525
MAIL_USERNAME=null
MAIL_PASSWORD=null
MAIL_ENCRYPTION=null
```

in config/database.php

```
'default' => env('DB_CONNECTION', 'mysql'),
```

Additional Tools

- Blade: UI templating tool
- Artisan: Utility tool to help developer
- Composer: Dependency manager for php (similar to make tool)
- Tinker: Tool to help developer run and try methods on server side

Literature – LARAVEL

- Documentation
 - See <https://laravel.com/docs/5.3/> (incl. installation)
- BEST RESOURCE FOR LEARNING LARAVEL
 - <https://laracasts.com/series/laravel-5-from-scratch> (there are 18 screencasts walking you thru the materials)

EVENT-DRIVEN PROGRAMMING WITH JAVAFX

Graphical User Interfaces with JavaFX

- Design and build graphical user interfaces (GUI)
- Event-driven software development
- Can use large libraries
- Good practices in user-interface development!
- Possibility to deploy in the Browser
 - There is a JavaScript API (Java Plugin) to simplify web deployment of JavaFX applications
 - Use JavaFX for rich client applications with a lot of interactive elements

Graphical user interfaces in Java

- There are several interfaces in Java for creating GUIs
- In Java integrated (supplied) interfaces:
 - **A**bstract **W**indow **T**oolkit (AWT)
 - Swing
 - JavaFX
- Alternative interfaces (not integrated in Java):
 - **S**tandard **W**idget **T**oolkit (SWT)
 - Uses GUI components from the underlying platform and tries to combine the best of AWT and Swing.
 - Efficiency issues on non-Windows platforms due to missing features (SWT library must be included with the application).
 - JFace (extension of SWT)

Light vs. heavyweight components

- **Lightweight components**

- Are not bound to platform-specific component.
- Must be drawn ultimately on a heavyweight component.
- Look the same on all platforms.
- Emulating the look of the target platform is expensive.

- **Heavyweight components**

- Are bound to a platform-specific component.
- Only the intersection of the components available on all target platforms is usable
- Components not offered on the platform need to be recreated "by hand".

Abstract Window Toolkit (heavyweight)

- **Uses** the GUI components offered by the **underlying platform**.
- There are only GUI components that exist on all platforms supported by AWT.
- Creation of complex GUI very expensive: GUI components, such as progress bar, must be created by hand.
- But: (almost) just as **fast** GUI as in native applications.

Swing and JavaFX (lightweight)

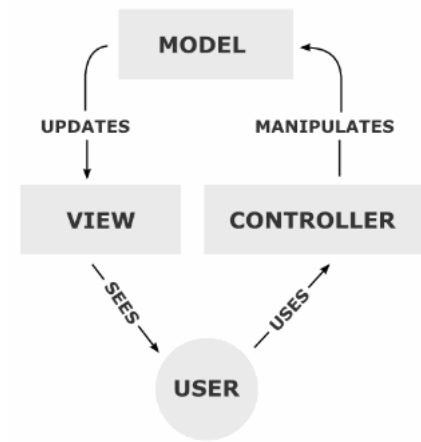
- Uses only **windows** and **drawing** operations of the underlying platform.
- Swing applications are **resource-hungry** and often **slower** than to use AWT or other platform-specific applications.
- This problem is often intensified by awkward programming:
 - E.g. **JFileChooser** (Swing): Rebuild each time instead of reconfiguring only
 - **JFileChooser** provides a simple mechanism for the user to choose a file.

JavaFX

- Should replace Swing in the medium-term
- Better support for devices with very different graphical display options (smartphone vs. desktop)
- Supports better the **Model/View/Controller** architecture pattern than Swing by separating the program logic (written in Java) from the GUI (written in FXML).
 - FXML is an XML-based language that provides the structure for building a user interface separate from the application logic of your code.
- Supports and uses DirectX and OpenGL

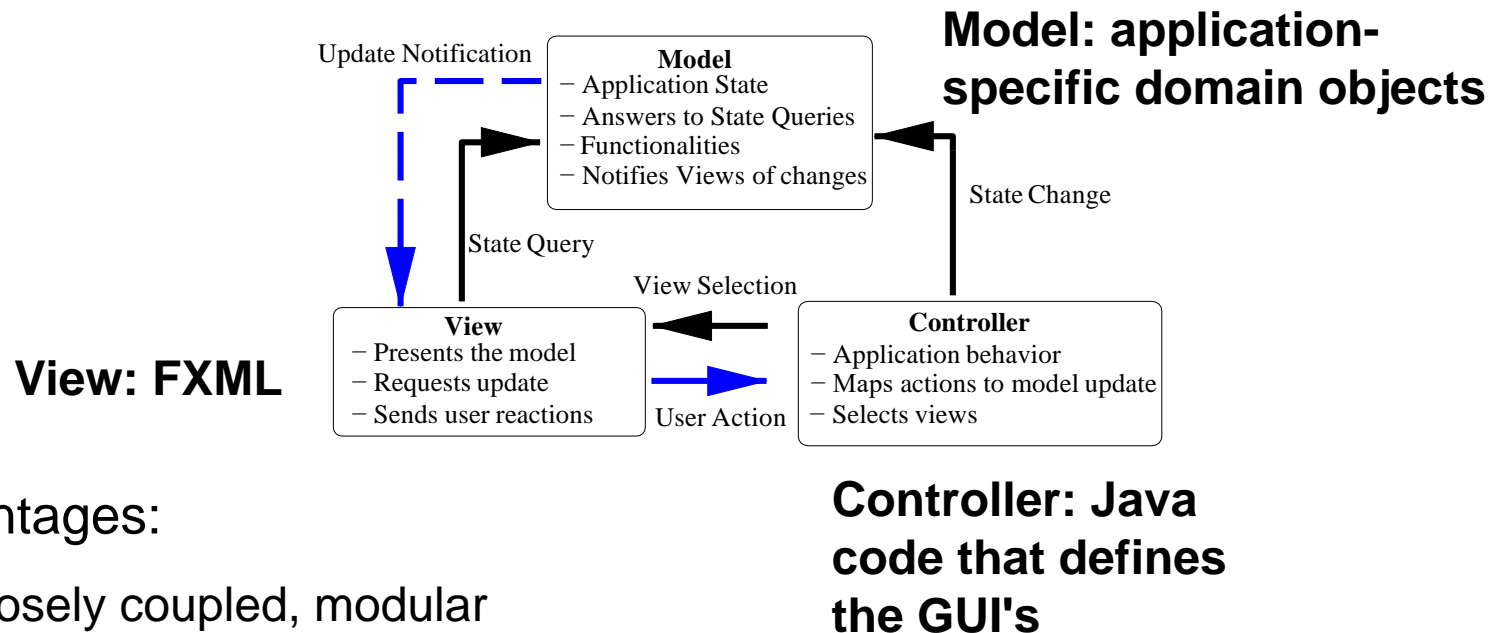
Recap: Model/View/Controller (MVC)

- MVC is a class combination (components) for constructing user interfaces (first created in Smalltalk).
 - Model: Application object (data and the state of the object)
 - View: Display of the model on the screen (possibly several times)
 - Controller: Defines user interface response to inputs (event reaction)
- More in the section "Architectural Styles"



MVC in JavaFX

- The central theme of JavaFX: Model-View-Controller architecture:



- Advantages:
 - Loosely coupled, modular
 - Model with different views
 - Controller decides when/how to update the model and/or the view
 - Model can change the view

MVC in JavaFX

- **Enforce Model-View-Controller (MVC) with FXML**
 - The "Model" consists of application-specific domain objects
 - The "View" consists of FXML
 - The "Controller" is Java code that defines the GUI's behavior for interacting with the user.

Sample application in Swing

```
import java.awt.event.*;  
import javax.swing.*;
```

Import the required packages

```
public class HelloWorld extends JFrame {
```

Inherits from the main window class

```
    public HelloWorld() {
```

Call constructor of JFrame with the title of the window.

```
        super("Hello world!");
```

```
        JButton button = new JButton("01 + 01 = ?");
```

Create a button with the specified caption.

```
        button.addActionListener(new ActionListener() {  
            public void actionPerformed(ActionEvent e) {  
                JOptionPane.showMessageDialog(null, "01 + 01 = 10",  
                    "Answer:", JOptionPane.QUESTION_MESSAGE);  
            }  
        });
```

Specify what should happen on an action on the button.

```
    });
```

Add a button to the window.

```
    this.add(button);
```

```
    this.setDefaultCloseOperation(EXIT_ON_CLOSE);
```

Specify the action to be triggered when the window is closed.

```
    this.pack();
```

Adjust the window size, adapt the arrangement of the components to the window size.

```
}
```

```
public static void main(String[] args) {
```

```
    HelloWorld window = new HelloWorld();
```

```
    window.setVisible(true);
```

Displays the created window.

```
}
```

```
}
```

Sample application in JavaFX

```
public class HelloWorld extends Application {  
    public static void main(String[] args) {  
        launch(args);  
    }  
    @Override  
    public void start(Stage primaryStage) {  
        primaryStage.setTitle("Hello world!");  
        Button btn = new Button();  
        btn.setText("01 + 01 = ?");  
        btn.setOnAction(new EventHandler<ActionEvent>() {  
            @Override  
            public void handle(ActionEvent event) {  
                Stage dialogStage = new Stage();  
                dialogStage.initModality(Modality.WINDOW_MODAL);  
                VBox vbox = new VBox(); vbox.setAlignment(Pos.CENTER);  
                vbox.getChildren().add(new Text("Answer:"));  
                vbox.getChildren().add(new Button("01 + 01 = 10"));  
                dialogStage.setScene(new Scene(vbox));  
            }  
        });  
        StackPane root = new StackPane();  
        root.getChildren().add(btn);  
        primaryStage.setScene(new Scene(root, 300, 250));  
        primaryStage.show();  
    }  
}
```

Inherits from the main window class

Start the application
Note: Call launch(), JavaFX will call start().

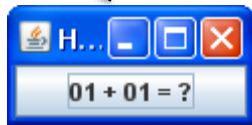
Create a button with the specified caption.

Specify what should happen on an action on the button.

Add a button to the window.

Sample application: Appearance

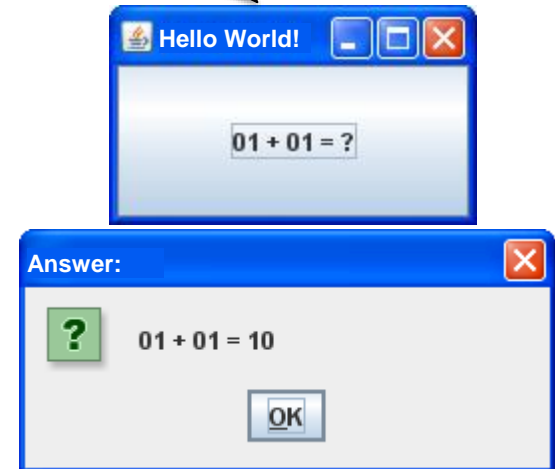
After the start.



After manual enlargement.



After clicking on the button.



Creating windows: Stage

- Windows are usually created in JavaFX with the class **Stage**.
- Then you can set additional properties of the window and place GUI components.

Creating windows: Stage – Example (1)

```
@Override
public void start(Stage stage)
{
    // Set the title of the Stage
    stage.setTitle("Stage with a Button in the Scene");
    // Create the Button
    Button button = new Button("Hello");
    // Create the VBox
    VBox root = new VBox(button);
    // Create the Scene
    Scene scene = new Scene(root, 200, 100);
    // Add the Scene to the Stage
    stage.setScene(scene);
    // Set the width and height of the Stage
    stage.setWidth(400);
    stage.setHeight(100);
    // Display the Stage
    stage.show();
}
```

Source: <https://examples.javacodegeeks.com/desktop-java/javafx/javafx-stage-example/>

Creating windows: Stage – Example (2)

- Resulted GUI:



Source: <https://examples.javacodegeeks.com/desktop-java/javafx/javafx-stage-example/>

Structure of a dialog window



Source: <https://examples.javacodegeeks.com/desktop-java/javafx/dialog-javafx/javafx-dialog-example/>

- Stage, Scene, Pane (Panels can be nested), button, labeling, text box ,...