COMP5347: Web Application Development

Server-side Development

Node.js

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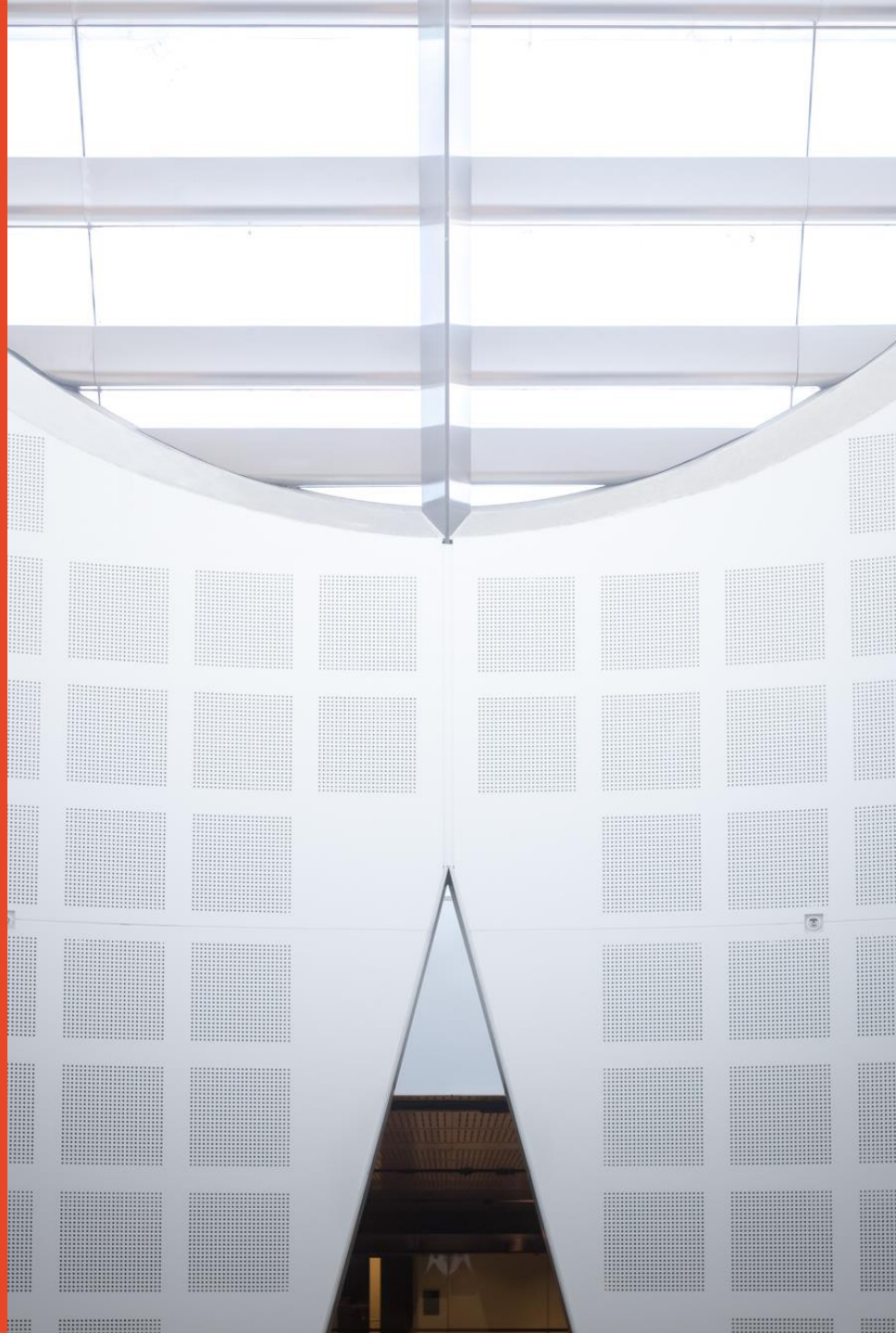
School of Computer Science



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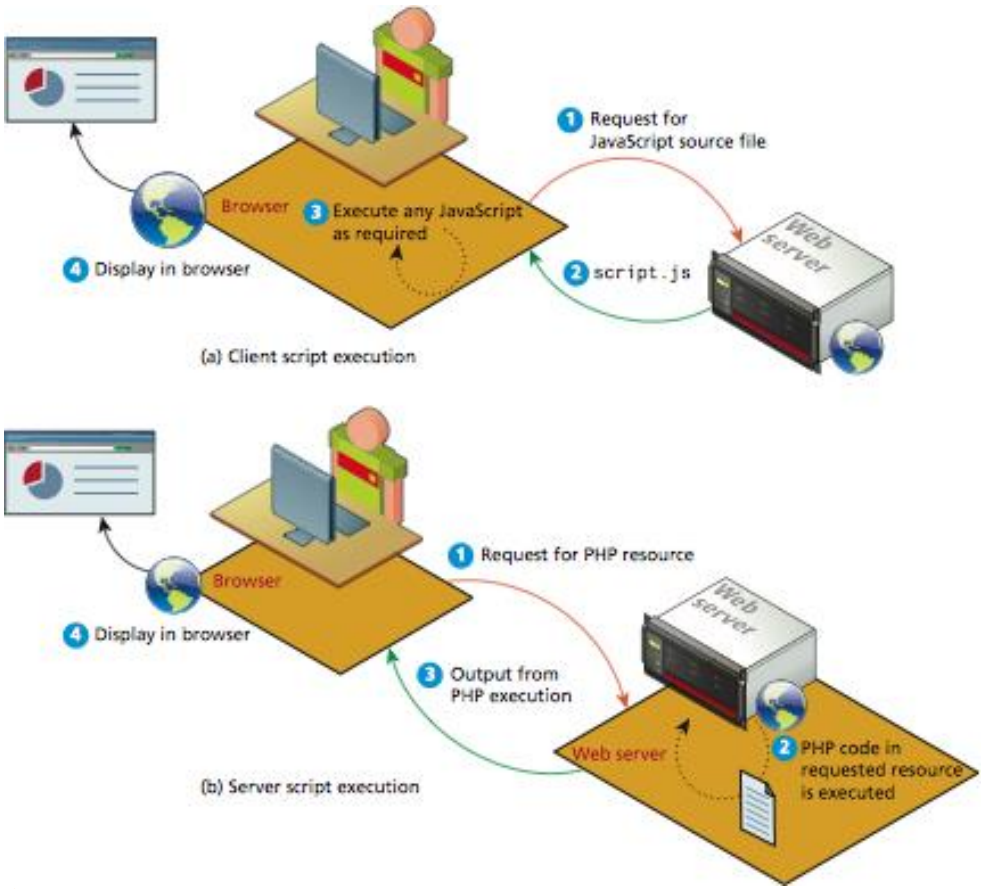
Outline

- How web server works
  - Forms
  - HTTP GET. POST
- Node.js Execution
- Node.js Application Structure
- Express.js Basics
  - Routing
  - Middleware
  - Template Engines

Server-side Development

- Server-side development involves the use of programming technology to create script that dynamically generate content

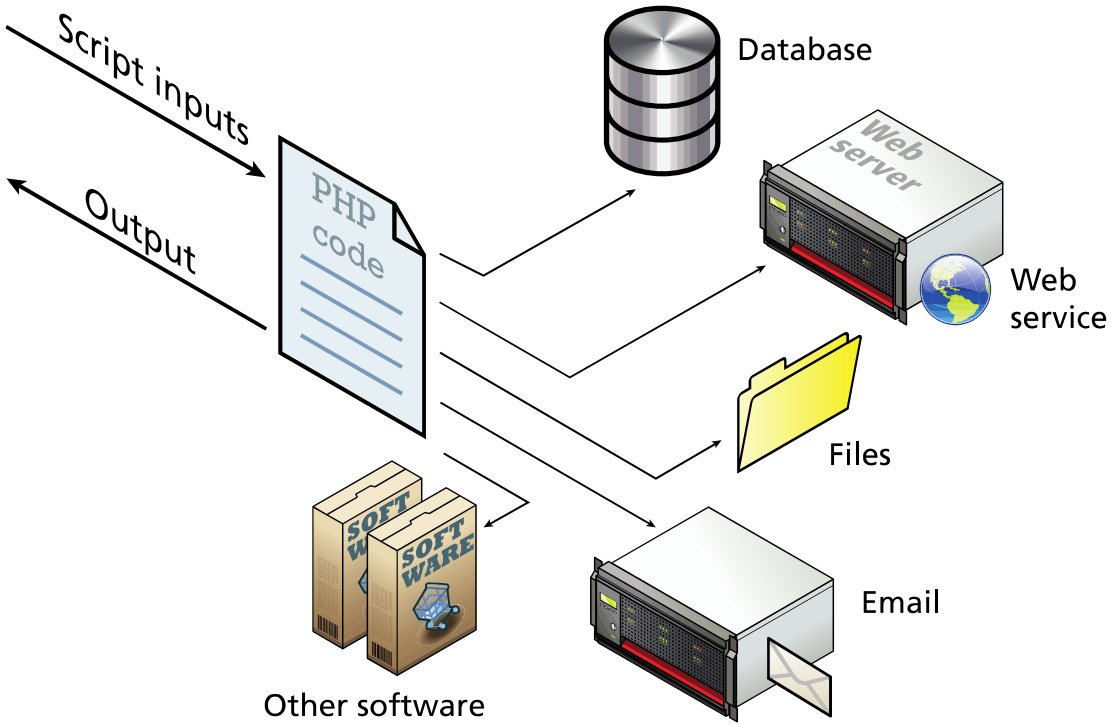
Execution of Client-side script (a) and server-side script (b)



- Server-side development technologies:
  - Java Server Pages
  - Active Server Pages (.NET)
  - PHP
  - Node.js
  - Ruby on Rails
  - Python

Server-side Development

- Server-side script: software running on a server and uses HTTP request-response loop for interaction with the clients
- A server-side script can access resources made available by the server



Common Server Types

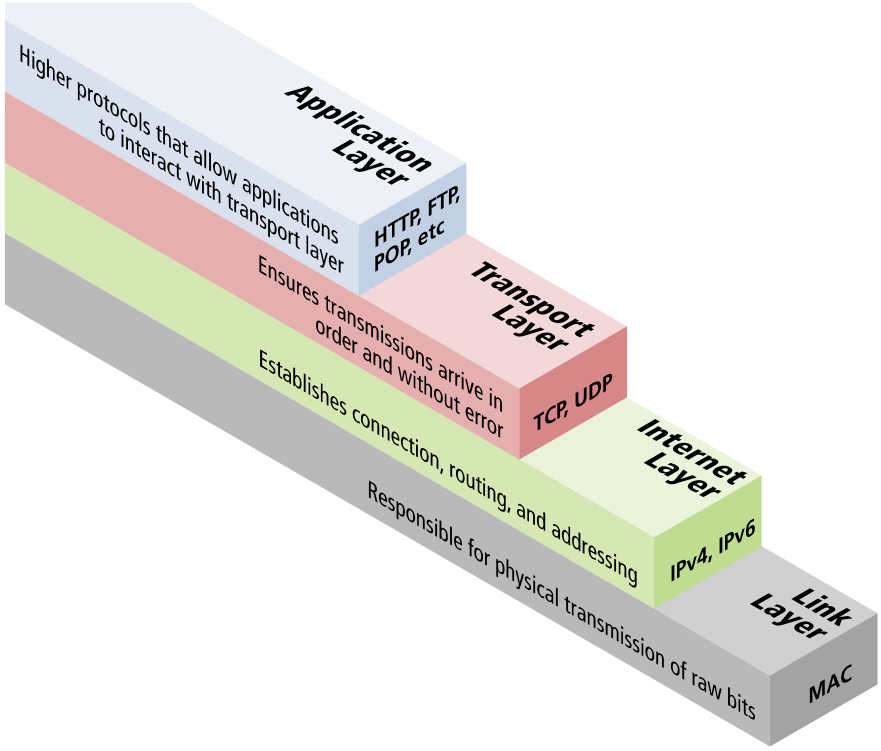
- Web Servers
  - A computer that runs a Web server software (e.g., Apache, MS IIS) and service HTTP requests
- Application Servers
  - A computer that hosts and execute Web applications developed in a certain technology; PHP, Ruby on Rails
- Database Server
  - A computer that is devoted for running a DBMS such as MySQL, SQL server
- Web servers must choose an **application stack** (OS, Web server software, database and scripting language for dynamic requests)
  - LAMP: Linux, Apache, MySQL and PHP
  - MEAN: MongoDB, Express.js, Angular.js, Node.js
- Server software should be installed and configured on the Server
  - N-tier architecture (physical/logical)

How server works - URLs

- Most basic web server acts like a file system while file requests are sent using HTTP protocol
  - Path: similar to a computer file system. The root of a web server correspond to a folder somewhere on the server.
  - Linux servers the path is /var/www/html

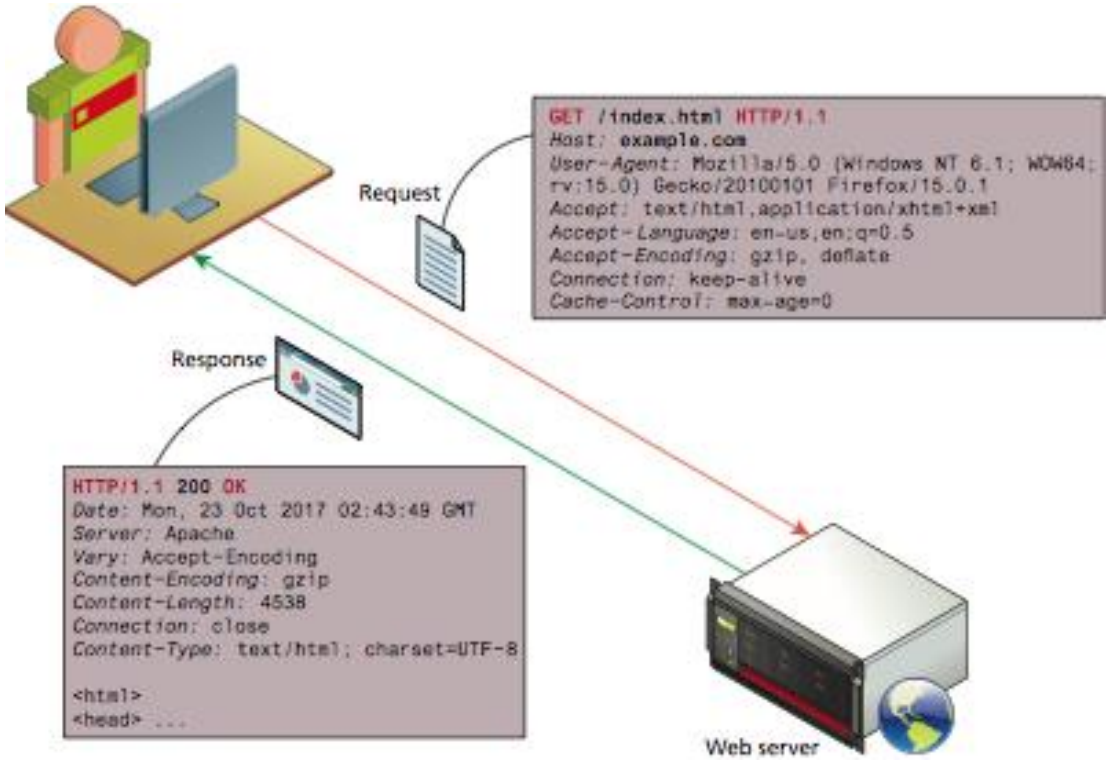
Internet Protocols – HTTP

- Transport layer protocol (e.g. TCP) provides logical communication between processes running on the *hosts identified by ip:port*
  - In particular, TCP ensures that transmissions arrive, in order, and without error
- Application layer protocol (e.g. HTTP) defines the *syntax and semantics of the message send between processes*

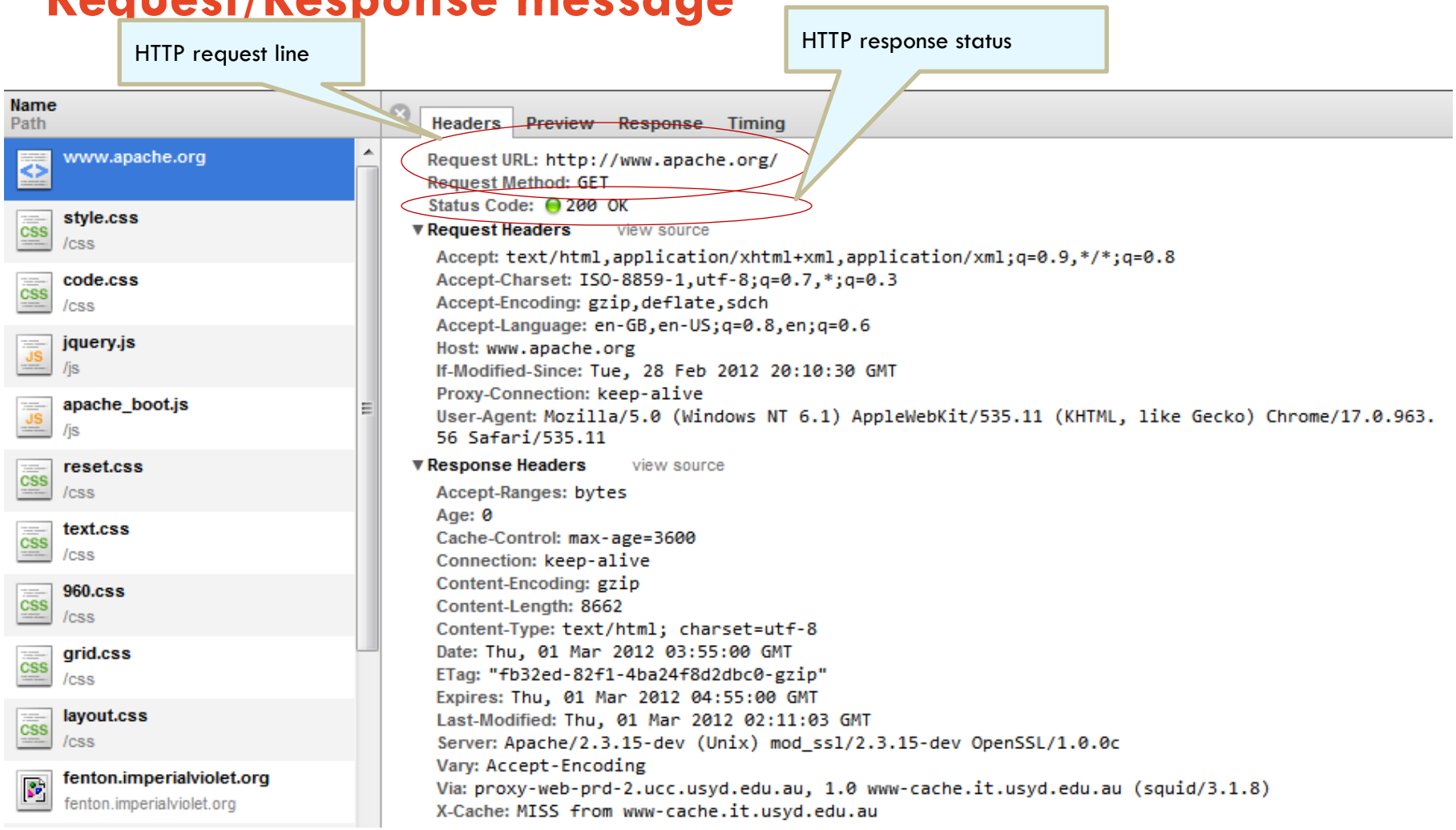


HTTP Headers

- **Request headers** include data about the client machine.
- **Response headers** have information about the server answering the request and the data being sent



Request/Response message



Request Methods

HTTP/1.0

- GET
- POST
- HEAD
  - asks server to leave requested object out of response

HTTP/1.1

- GET, POST, HEAD
- PUT
  - uploads file in entity body to path specified in URL field
- DELETE
  - deletes file specified in the URL field

HTTP Response Status Code

- 3 digit response code
  - 1XX – informational
  - 2XX – success
    - 200 OK
  - 3XX – redirection
    - 301 Moved Permanently
    - 302 Found/Moved temporary
    - 303 Moved Temporarily
    - 304 Not Modified
  - 4XX – client error
    - 404 Not Found
  - 5XX – server error
    - 505 HTTP Version Not Supported

HTTP Request Processing

- Address Resolution
  - Simple example
    - A file stored under the absolute path

      /usr/mit/*yourlogin*/lib/html/week2.html
    - Is accessible through this URL:

      http://www.it.usyd.edu.au/~*yourlogin*/week2.html
  - Apache administrator has set the mapping between URL path info and local file system path info
    - /~*yourlogin*/week2.htm is mapped to /usr/mit/*yourlogin*/lib/html/week2.html in local file system

Static and Dynamic Content

- Static content stored in local file system
  - Static content page: HTML page, plain text, image files, etc
    - Use the predefined mapping to locate the file
    - Construct HTTP response with header information
  - *As-is page*: static file containing complete HTTP responses
    - No response construction is required
    - Indicate is-as file (e.g., extension)

- Dynamic contents request explicit server side programmatic action to generate response
  - PHP, Perl scripts
  - Application server

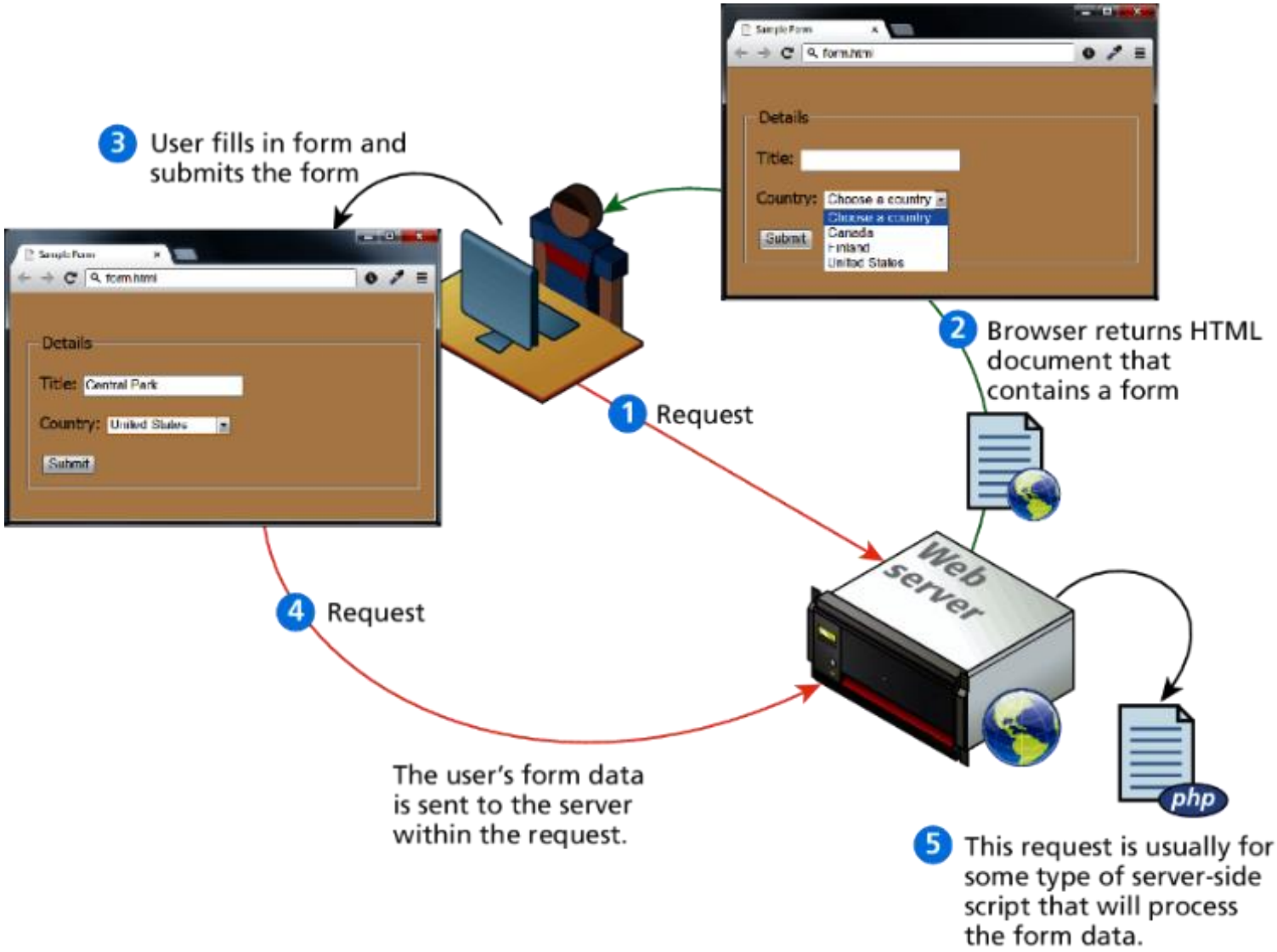
Server-Side Program Forms

- As a "script"
  - CGI scripts, or Java Servlets, or JavaScript
  - Just like a regular program
  - Parse request using regular expression
  - Write (HTML) response using stream operations provided by the language
- As a Server Page (template processing)
  - PHP, ASP, JSP
  - Program is structured around the returning text page
  - Script code are inserted into the HTML code to execute at certain points
- Combination based on MVC

Server-Side Program

- Basic processing steps
  - Parse HTTP request to obtain information carried in the request
  - Processing the HTTP request information
  - Generate response
- "script" style program regardless of the language chosen
- They are hidden in "server page" style program
- Supporting/external services for
  - networking
  - Common processing
- Supported by server (e.g., application server) or language framework

Sending data to server



HTML Forms – Query Strings

How the browser sends the data to the server

- Through HTTP requests
- The browser packages user's data into a query string
- Query string: a series of name=value pairs separated by &
  - HTML form element's name attribute
  - User input data

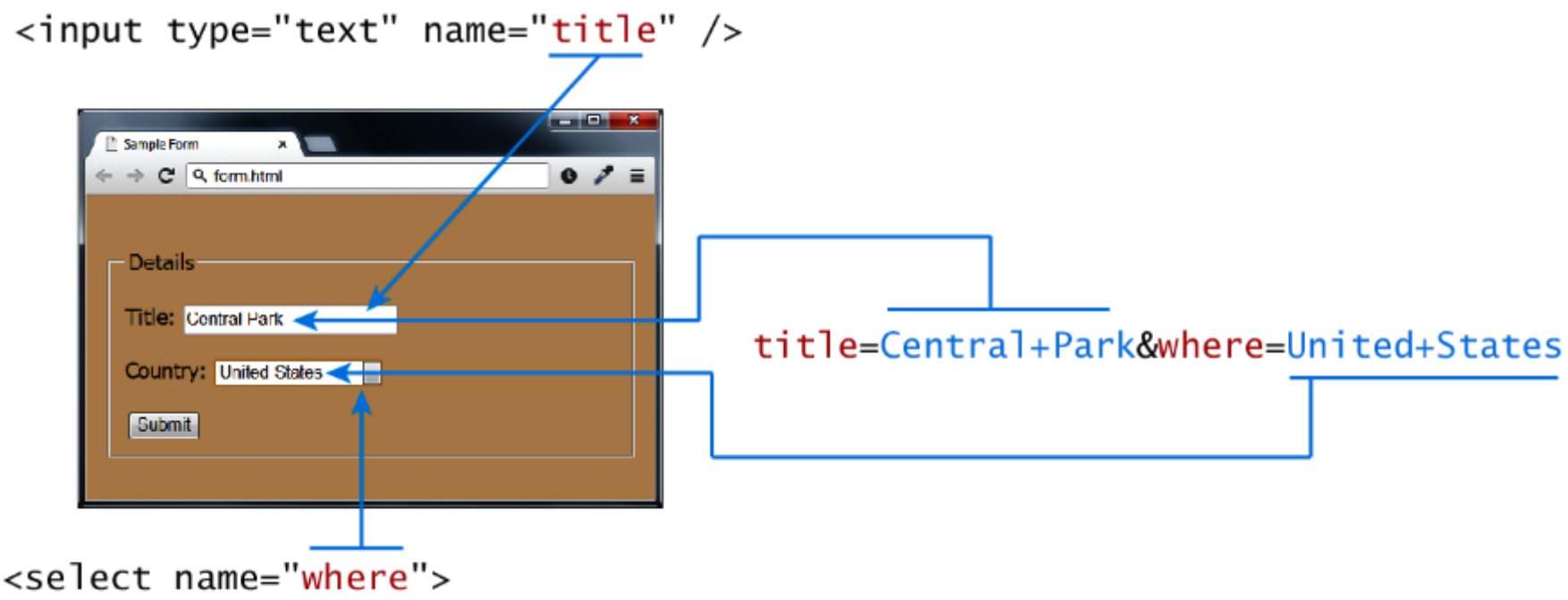
<form> Element

- There are two essential features of any form, namely the **action** and the **method** attributes
  - The **action** attribute specifies the URL of the server-side resource that will process the form data
  - The **method** attribute specifies HTTP request method
    - GET
    - POST

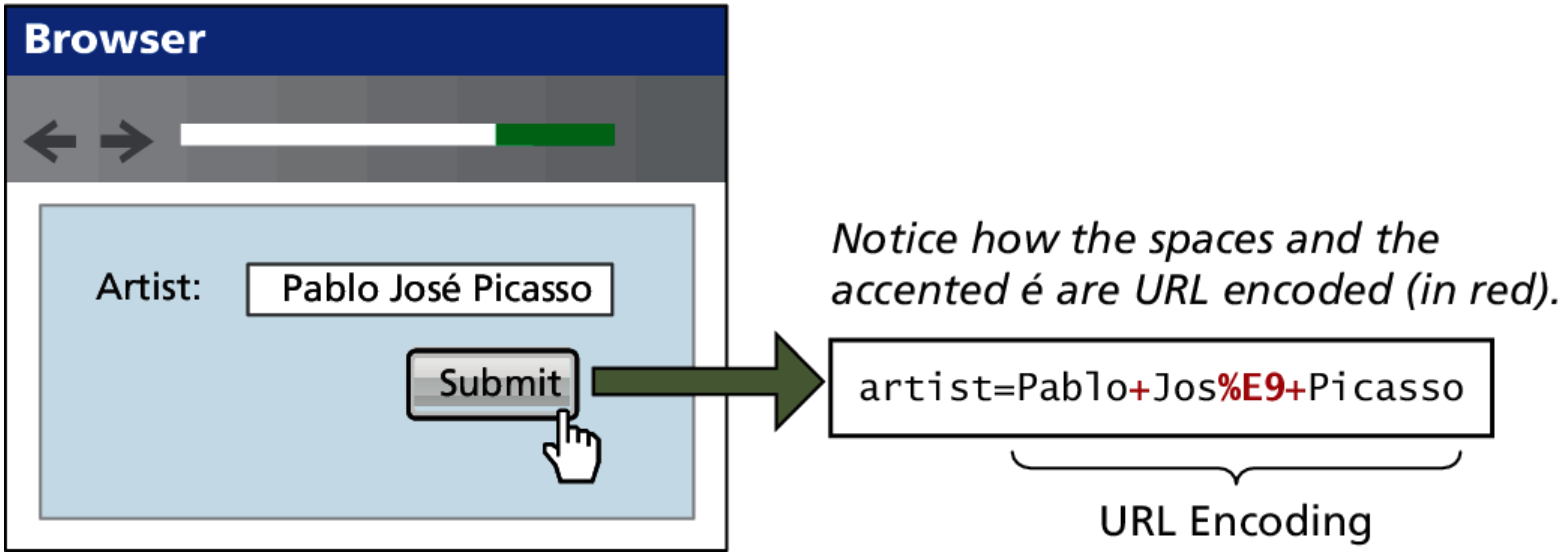
- GET and POST methods send form data to server in different ways

GET Method

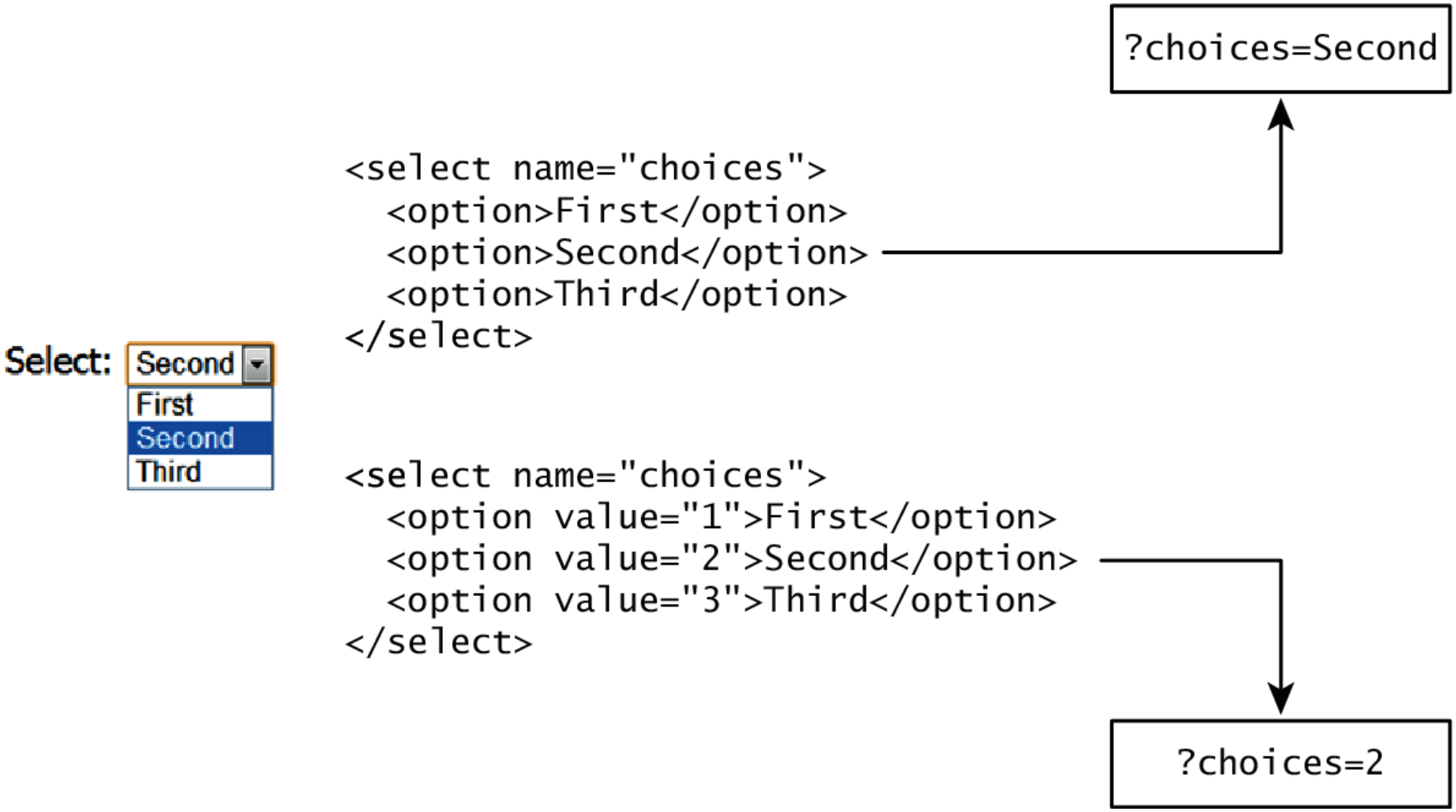
- GET method attached the form data as query string to URL
- General format of query string
  - http://example.com/over/there?title=test&where=here



URL Encoding



Which Value to Send



Radio Buttons and Checkboxes

Continent:
- North America
- South America
- Asia

```
<input type="radio" name="where" value="1">North America<br/>
<input type="radio" name="where" value="2" checked>South America<br/>
<input type="radio" name="where" value="3">Asia
```

I accept the software license ☑

```
<label>I accept the software license</label>
<input type="checkbox" name="accept" >
```

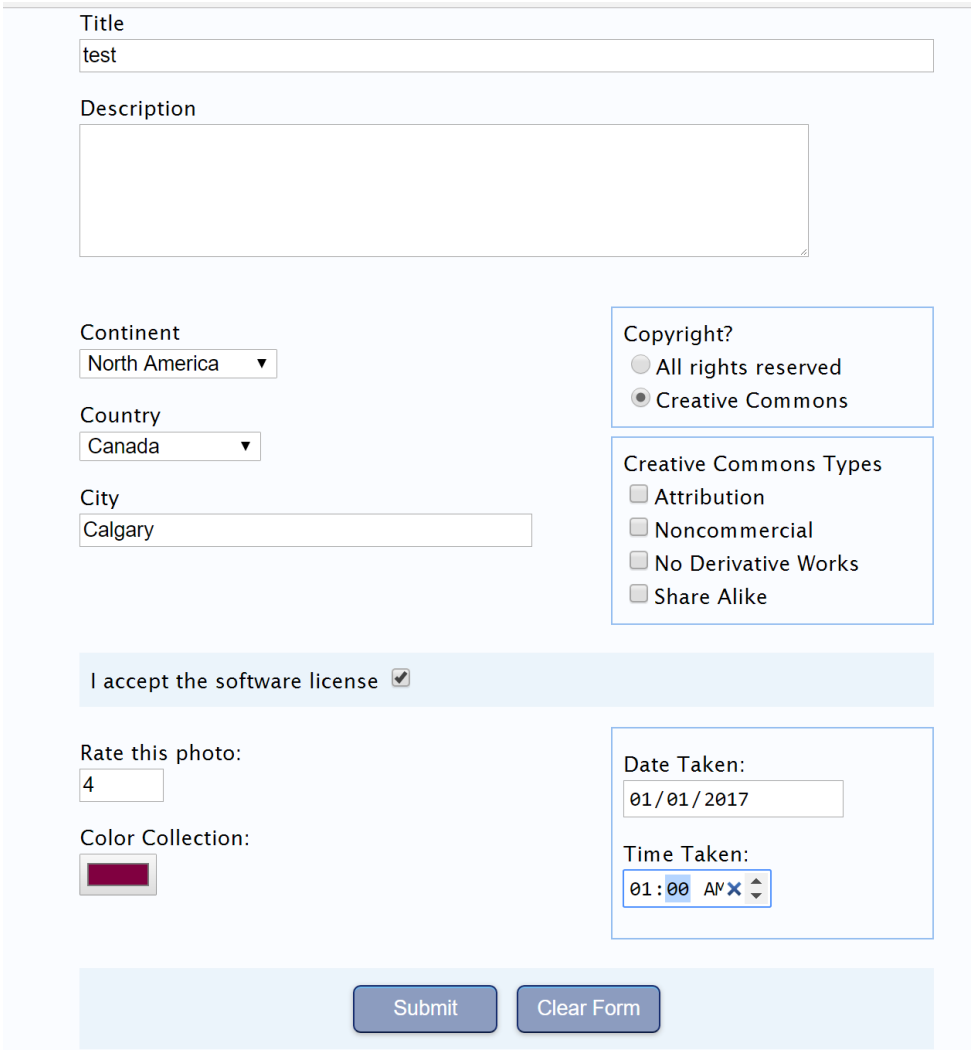
Where would you like to visit?
- ☑ Canada
- ☐ France
- ☑ Germany

```
<label>Where would you like to visit? </label><br/>
<input type="checkbox" name="visit" value="canada">Canada<br/>
<input type="checkbox" name="visit" value="france">France<br/>
<input type="checkbox" name="visit" value="germany">Germany
```

?accept=on&visit=canada&visit=germany

POST Method

- POST method sends the form data as part of request body



POST request body

× Headers Preview Response Timing

▼ **General**

Request URL: file:///C:/Users/yzho8449/course/comp5347/2017/labs/code/week5-lecture/week3.html

▼ **Request Headers**

⚠ **Provisional headers are shown**

Content-Type: application/x-www-form-urlencoded

Origin: null

Upgrade-Insecure-Requests: 1

User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/56.0.2924.87 Safari/537.36

▼ **Form Data** view source view URL encoded

title: test

description:

continent: North America

country: Canada

city: Calgary

copyright: 2

accept: on

× Headers Preview Response Timing

▼ **General**

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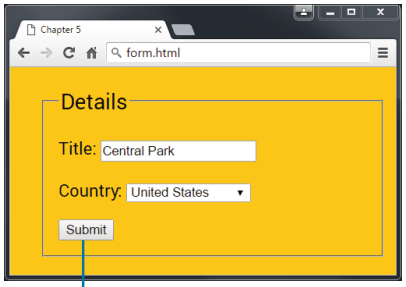
▼ **Form Data** view parsed

```
title=test&description=&continent=North+America&country=Canada&city=Calgary&copyright=2&accept=on&rate=4&color=%23800040&date=2017-01-01&time=01%3A00
```

GET vs POST Method




```
<form method="get" action="process.php">
```

```
GET /process.php?title=Central+Park&where=United+States http/1.1
```

query string

```
<form method="post" action="process.php">
```

```
POST /process.php http/1.1
Date: Sun, 21 May 2017 23:59:59 GMT
Host: www.mysite.com
User-Agent: Mozilla/4.0
Content-Length: 47

title=Central+Park&where=United+States
```

HTTP Header

query string

GET vs. POST

- GET
  - Explicit in the address bar
  - Browser's history and cache
  - Bookmarking
  - Limit number of characters
    - IE 2083 characters, Apache web server 4000 characters
- POST
  - Contain binary data
  - Hidden from user
  - Not cached, bookmarked or in history

GET vs. POST

- Implication
  - GET to **query** something (**without changing** any server data)
  - POST for sending data and **change something** on the server

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- **Node.js Execution**
- Node.js Application Structure
- Express.js Basics
  - Routing
  - Middleware
  - Template Engines

Node.js Motivation

- Nod.js design goal is *performance* (makes it popular)
- Node.js' server architecture is different
- Any web server is expected to handle a large number of user requests concurrently
  - In early days, each request is handled by a *process*
  - Most *modern* servers handle request at *thread* level
    - Each request is handled by a separate *thread*
    - Server usually maintains a thread pool
      - Thread is allocated fraction system resources
    - Max. concurrent thread number
- Node.js server runs on a **single thread**

JavaScript

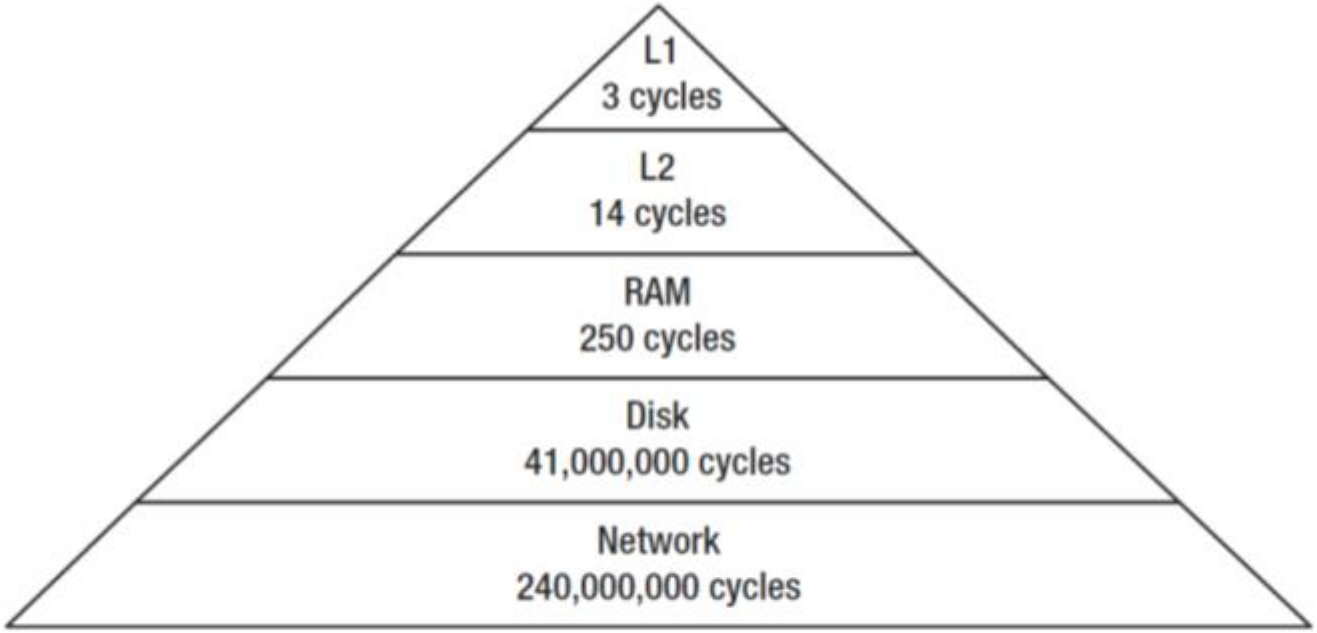
- JavaScript is synchronous, blocking and single-threaded language
  - One operation can be in progress at a time
  - Expensive database call?
    - Slow execution

- JavaScript code can be written to allow asynchronous behaviour
  - Asynchronous callbacks to invok a callback function
    - Send request, wait for response while the rest of the code continue running
    - Results sent back for processing through event loop
      - *Event loop:* a process that constantly checking if there's anything required to be called

Single Threaded Execution

- Node.js server handles all requests in a **single thread**
- JavaScript is designed to run in a single thread, both in browser and on server side
  - *Event loop* and *callback* for *non-blocking*, *asynchronous execution*
    - Longer running processes: at least an event signaling the end of the that process
      - Implement a callback function for that "end" event
    - E.g.
      - Disk IO done by OS's file management component
      - Database call is executed mainly on database server
      - Downloading post request data (uses network resources)

The IO Scaling Problem



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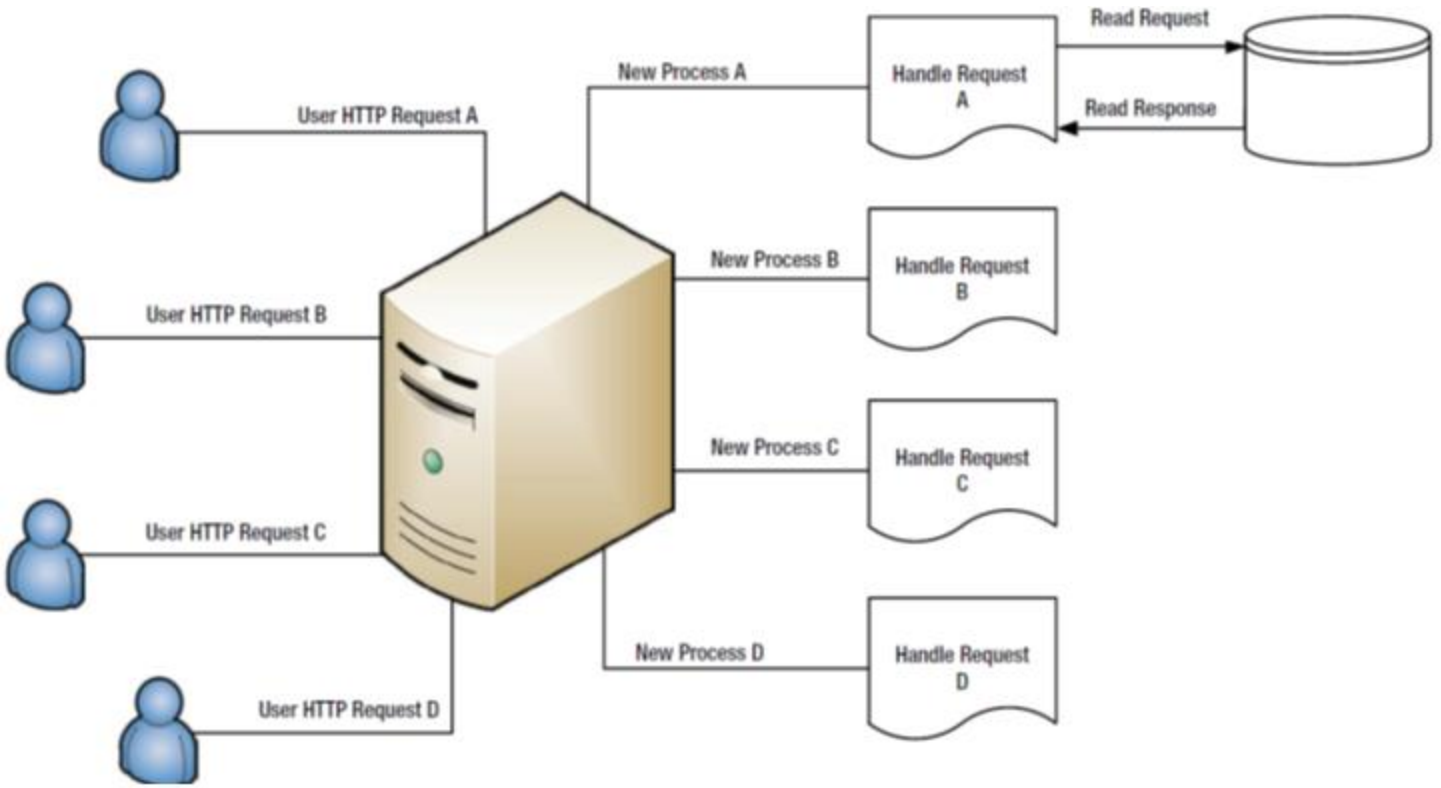
Traditional Server using Processes



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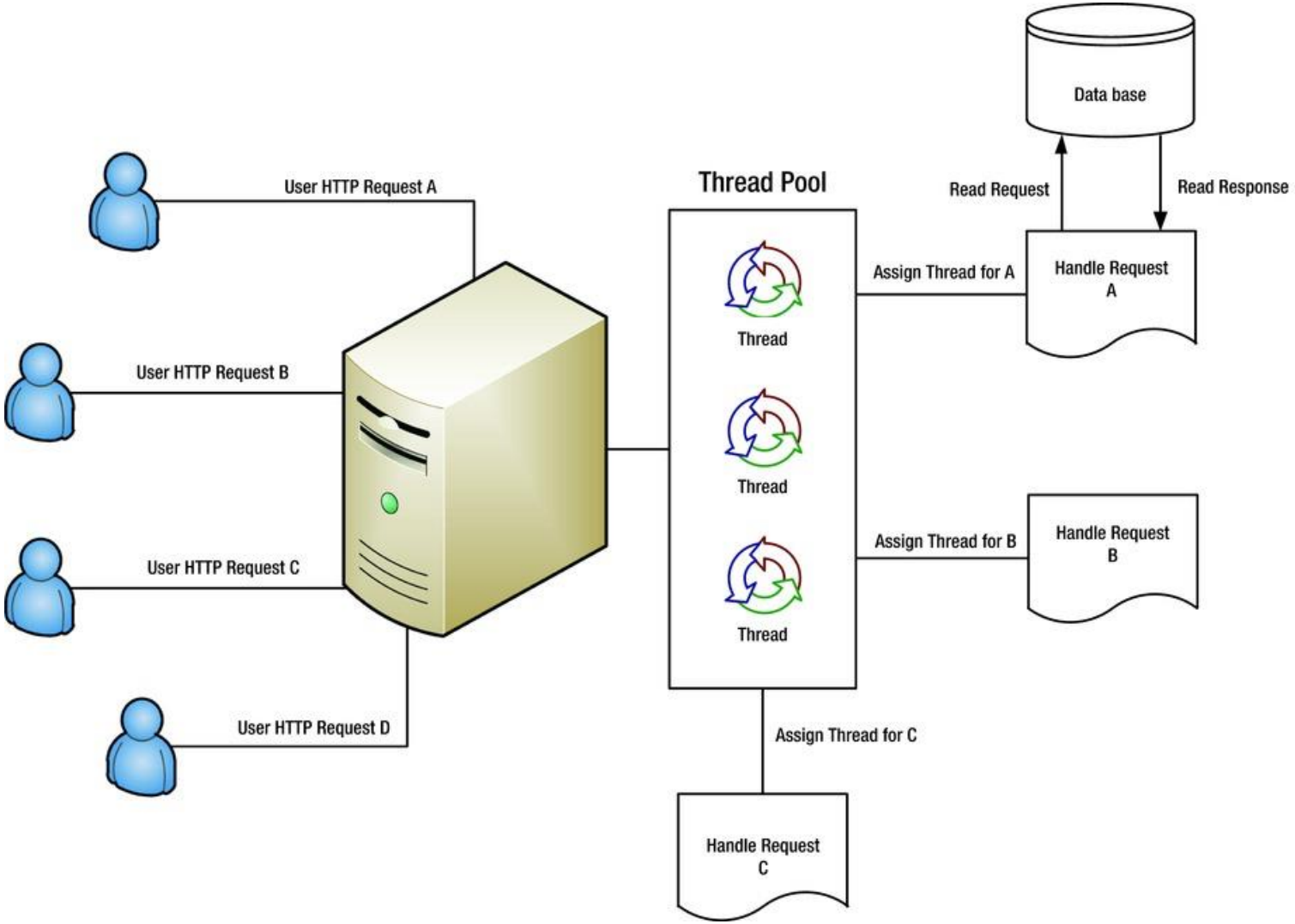
Servers with Multi-Threaded Execution



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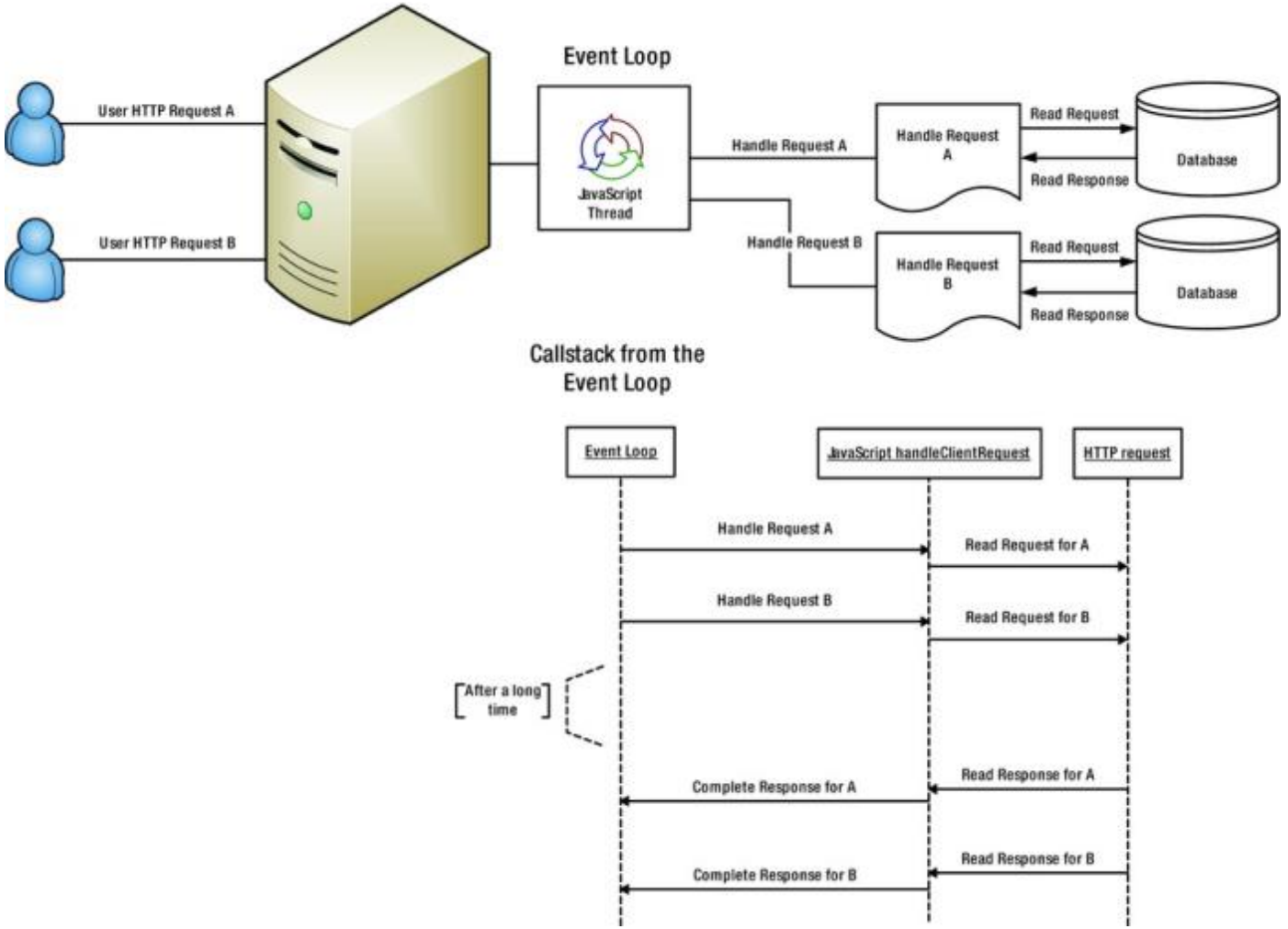
Asynchronous Request Handling



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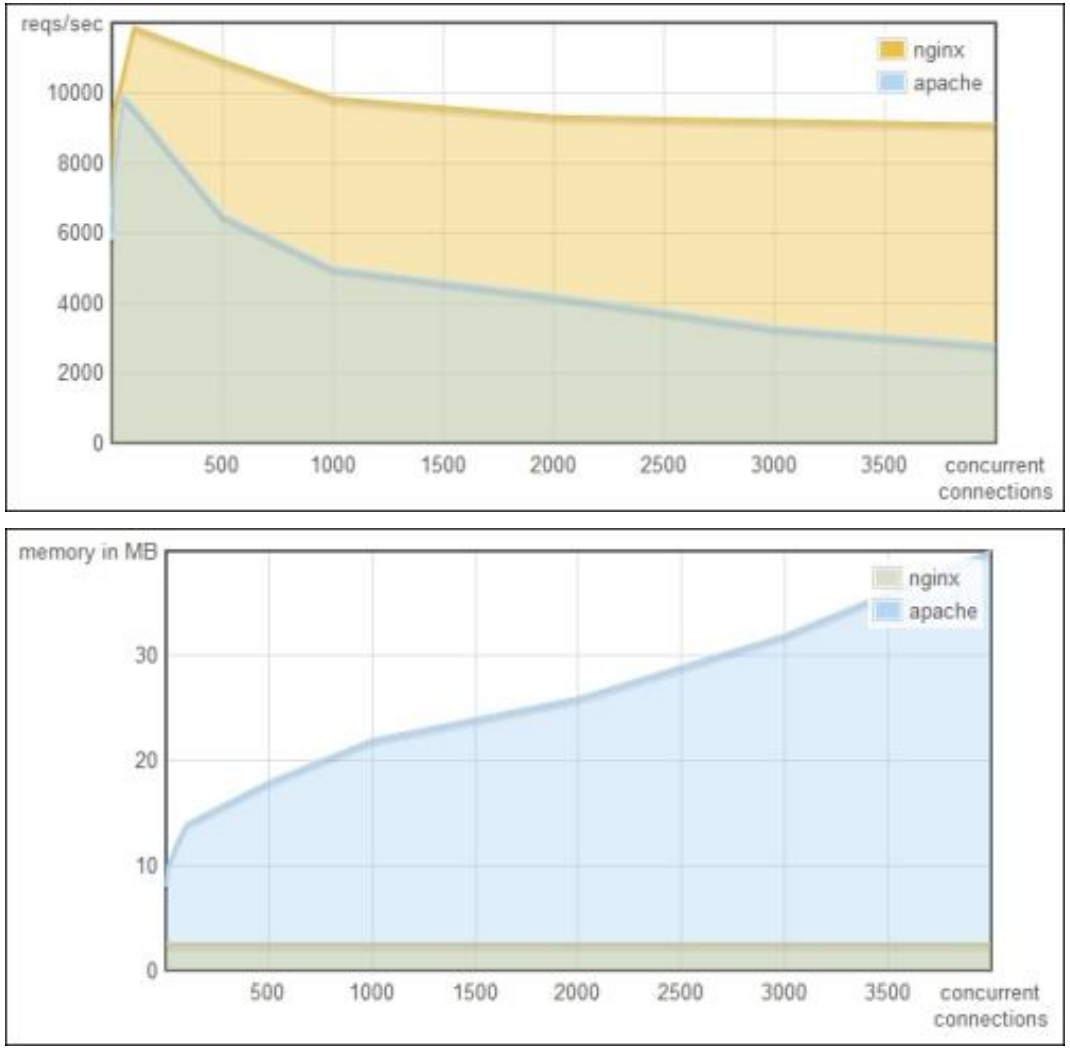
Single vs. Multi-threaded – Performance Comparison



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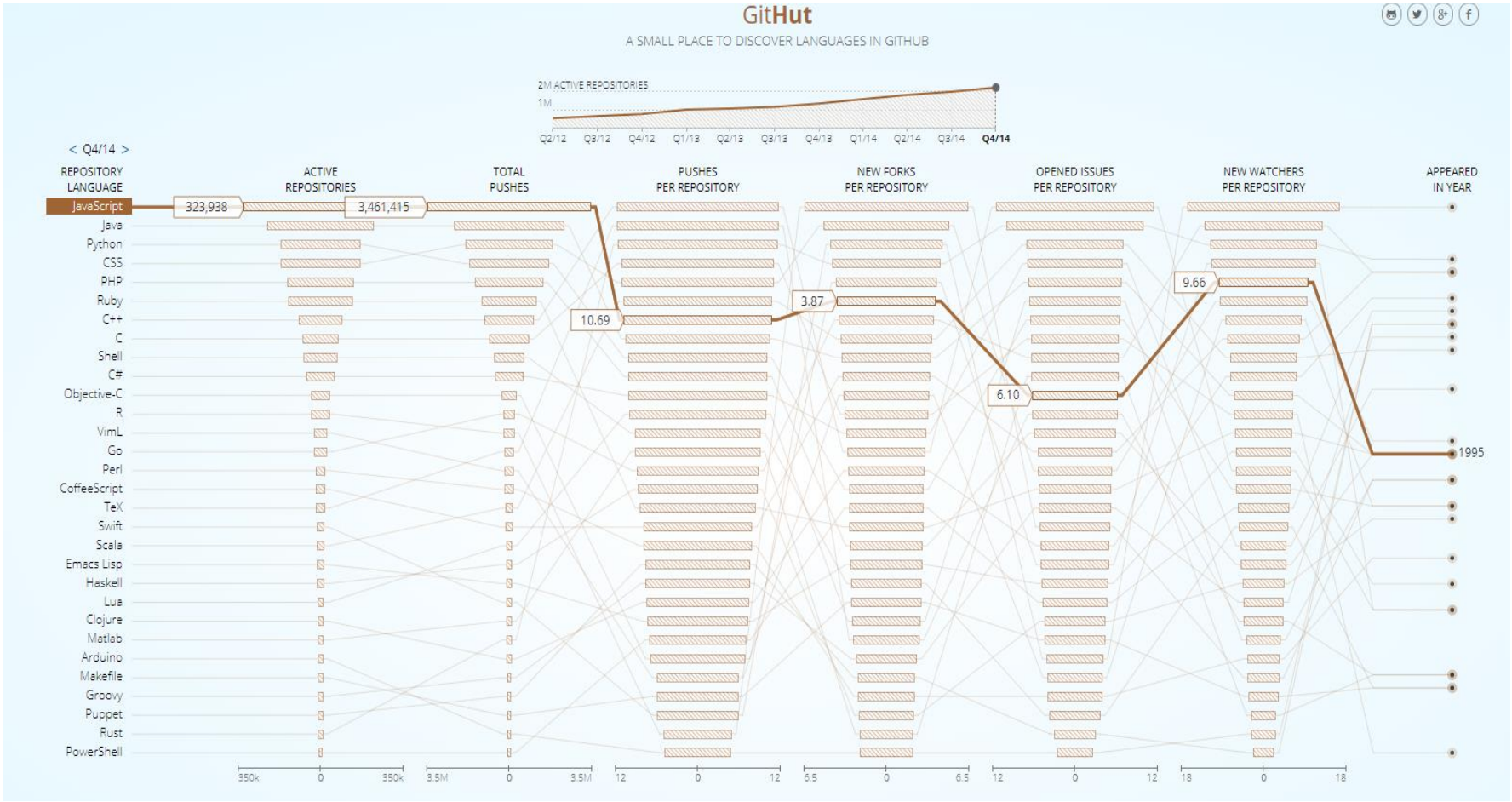
Java Script – Popularity



http://githut.info/

Outline

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- Node.js Execution
- **Node.js Application Structure**
- Express.js basics
  - Routing
  - Middleware
  - Template Engines

JavaScript – Global 'things'

- Many APIs are globally defined
- Unlike (OO language), JS code has many variables and functions that do not belong to a class /object
  - These are 'global' variable or functions
  - Belong to a global object
- Browser's global object window
  - variables, functions not belonging to some object/class belong to the **`window`** object and has global scope
  - **`document`** object's fully qualified name is **`window.document`**
- In large application, with third party code or framework, there might be conflict in global namespaces

Module System

- Module system is a way to organize namespaces defined in various script code in large JavaScript applications

- Node.js uses file-based module system (CommonJS)
  - Each file is its own module
  - Each file has access to the current module definition using the *module variable*
  - The export of the current module is determined by the ***module.exports*** variable
  - To import a module, use the globally available ***require*** function

Node.js Basic Components

- **`Node.js`** has a few important globals
  - console
  - process
  - require
  - __filename and _dirname
- **`Node.js`** is shipped with a few core modules
  - **`cli`**, **`fs`**, **`http`**
  - List of modules in Node.js (https://nodejs.org/api/modules.html)
- Many other useful modules to be downloaded separately
  - Using NPM (Node Package Manager) - https://www.npmjs.com/

Simple Node.js Application

```
var http = require('http')
var server = http.createServer(function(request, response) {
  response.writeHead(200, {"Content-Type": "text/plain"});
  response.write("Hello World");
  response.end();
});
server.listen(8888);
console.log("Web Server Running at http://localhost:8888 ... ");
```

Simple Node.js Application

```
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});
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```

require is a global function to import module .

createServer is a higher order function taking another function as parameter. It returns a server object.

The anonymous function with parameter **request** and **response** describe the application logic of the webserver.

console is a global object

Handling Multiple Requests

```
var http = require('http')
var server = http.createServer(function(req, resp) {
  if (req.url == <some pattern>){
      //write response
  }else if (req.url == <some other pattern>){
      //write response
  }else if (req.url == <…>){
      //write response
  }else{ // a not recognizable url
      // send back an error status code and
      // error message
  }
});
server. listen(8888);
console.log("Web Server Running at http://localhost:8888 ... ");
```

All requests are handled by a single thread

Handling Query String

Import another module with url parsing utilities

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

var server = http.createServer(function(req, res) {
  //targeting url like /sayHello?name=xxx
  if (req.url.indexOf('/sayHello') > -1){
     var query = url.parse(req.url,true).query;

     res.end('<body><h2> Hello '
        + query.name +
    '</h2></body></html>');

  }else{ // a not recognizable url. Send back an error status
        // code and error message
  }});
server. listen(8888);
console.log("Web Server Running at http://localhost:8888 ... ");
```

Handling POST Request Data

```
var http = require('http'),
    qs= require('querystring');

var server = http.createServer(function(req, res) {
 //targeting request like POST /sayHello with a body
 //name:xxx
  if (req.url.indexOf('/sayHello') > -1){
     var body = '';

     req.on('data', function(chunk){
         body += chunk;
     });

     req.on('end',function(){
         res.write('<body><h2> Hello '+
           qs.parse(body).name +
           '</h2></body></html>')
     });
  }else{ // a not recognizable url. Send back an error
         // status code and error message
  }});
server.listen(8888);
console.log("Web Server Running at
http://localhost:8888 ... ");
```

Handling POST Request Data

Post request contains a body part. The body may contain simple form data or large file in a uploading request

The request body is accessed through **data** event, so we listen to it, and save the received data in a variable.

When there is no more data, an **end** event fires. We listen to it to and call a function to generate the response.

Both handlers, defined as anonymous functions are able to access the local variable **body** of the outer function. This is called closure.

```
var http = require('http'),
    qs= require('querystring');

var server = http.createServer(function(req, res) {
 //targeting request like POST /sayHello with a body
 //name:xxx
  if (req.url.indexOf('/sayHello') > -1){
     var body = '';

     req.on('data', function(chunk){
         body += chunk;
     });

     req.on('end',function(){
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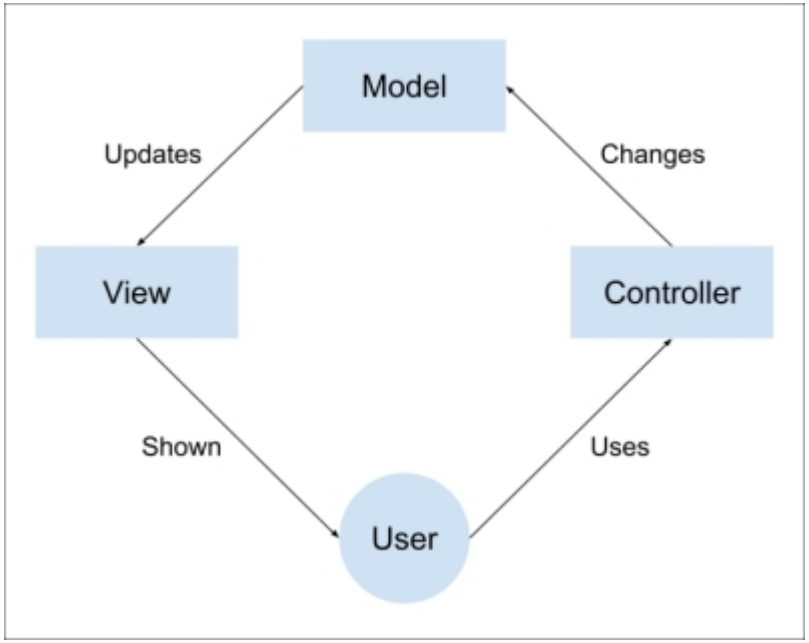
Web Application Structure

- The MVC pattern
  - What is the view technology (similar to early server page technology such as JSP)
    - *Template language* and template engines
      - A file that contains static and dynamic content
- Some framework to enable
  - URL / controller mapping
  - MVC wiring
  - Session management
  - Security management
  - …
- **Express** is a popular framework for building MVC node.js application

Common MVC Architecture

Business or application logic implemented in a programming language



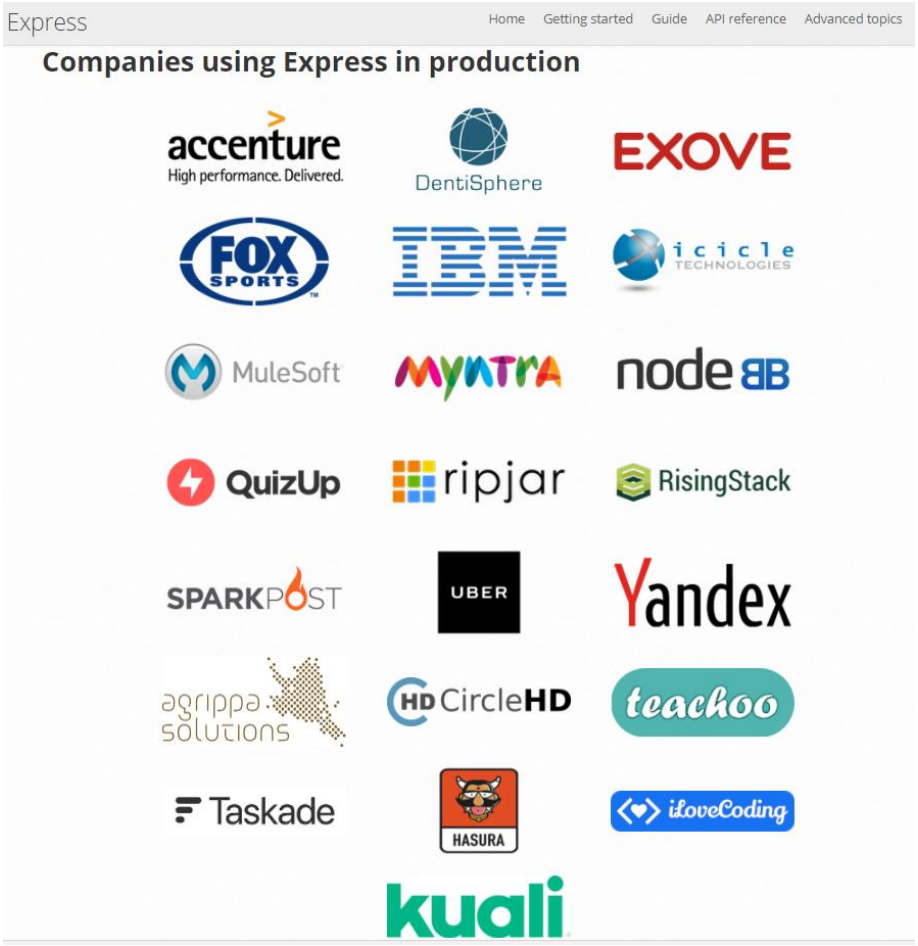
Usually a file with mixed static content (either in actual HTML or other mark down format) and processing logic and variables

Common processing such as network working, protocol handling usually provided by language framework, developers need to write code for customized processing

Express Framework

- Express is the framework that implements lots of common tasks when writing web app
  - Server setup
    - Manage the request response paradigm
    - Defines directory structure
  - Routing URL to code
  - Talk to template engine(s) to convert template files into proper response HTML
  - Remembering visitors for session support

Express.js – Popularity



https://expressjs.com/en/resources/companies-using-express.html

Express – Routing

- Routing: the mapping between HTTP request (method, url) to the piece of code handling the request
- Express routing take the following structure:
  - *app.METHOD(PATH,HANDLER)*
    - app is an instance of express
    - METHOD is an HTTP request method, in lowercase.
    - PATH is a path on the server.
    - HANDLER is the function executed when the route is matched.
- Example routing code

```
app.get('/', function (req, res) {
    res.send('Hello World!')
})
```

```
app.post('/', function (req, res) {
  res.send('Got a POST request')
})
```

https://expressjs.com/en/starter/basic-routing.html

Express – Question

```
var express = require('express')

var app = express()

app.get('/', function (req, res) {

      res.send('Hello World!')
})

app.listen(3000)
```

The express() function is a top-level function exported by the express module

The app object created by calling the express() and conventionally denotes the Express application

Q: What response the above application would return when the user types the following?
http://localhost:3000/HelloWorld

Express – Hello World Example

```
var express = require('express')

var app = express()

app.get('/', function (req, res) {

      res.send('Hello World!')
})

app.listen(3000)
```

The express() function is a top-level function exported by the express module

The app object created by calling the express() and conventionally denotes the Express application

Q: What response the above application would return when the user types the following?
http://localhost:3000/HelloWorld
A: the express server will responds with a "404 Not Found" as the server script (above) only respond to the root URL (/) or route

https://expressjs.com/en/4x/api.html

Express – app object

- The *app* object has methods for:
  - Routing HTTP requests; e.g., ***app.METHOD***
  - Configuring middleware; ***app.route***
  - Rendering HTML views; ***app.render***
  - Registering a template engine

- The *app* object also has settings (properties) that affect how the application behaves
  - ***app.mountpath*** property contains one or more path patterns on which a sub-app was mounted

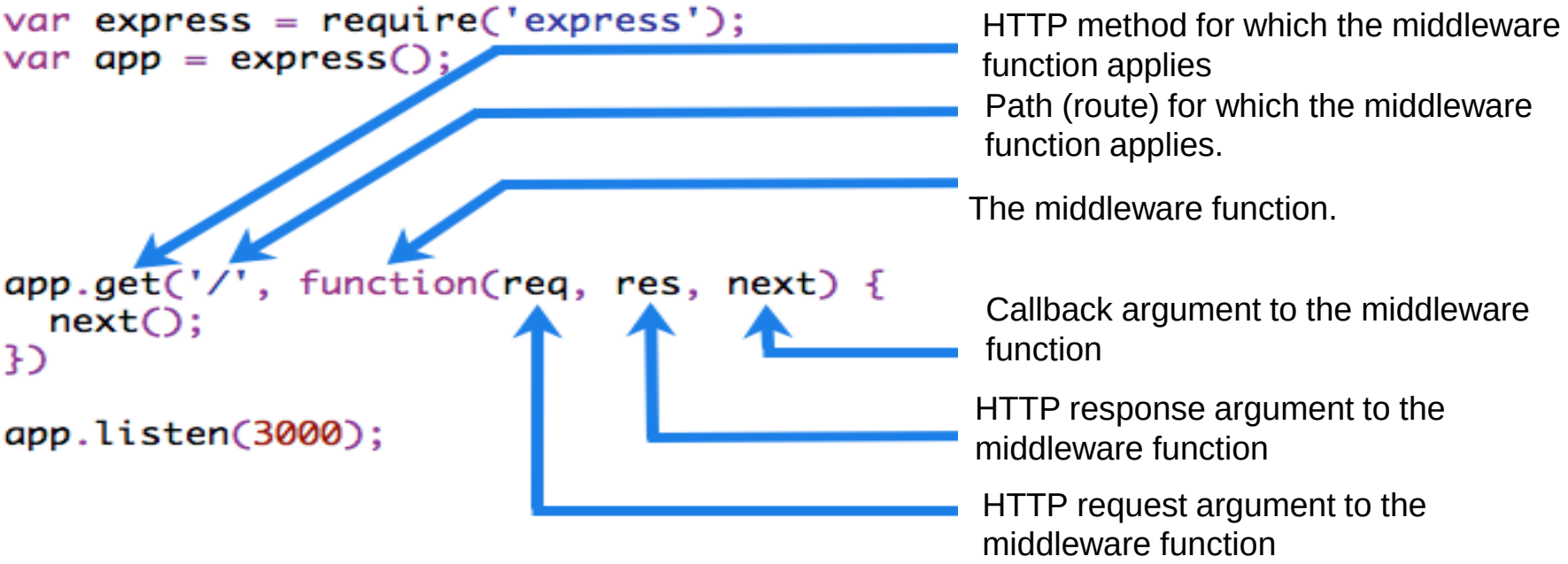
https://expressjs.com/en/4x/api.html#app

Middleware

- *Middleware* is a software (function) sits between the application code and some low-level API
- It has access to the request and response object
- It is used to implement common tasks on the request or response objects
  - In Java web dev. middleware is like filter where you can stack a lot of them before/after servlet
- The overall process would be
  - Client sends request
  - Request arrives at server
  - Handled by middleware 1, passed to *next function*
  - Handled by middleware 2, passed to *next function*
  - route method, passed to *next function*
  - Middleware 3, stop here

`https://expressjs.com/en/guide/writing-middleware.html`

Middleware stack



Route method is also a middleware, most of the time we call it *route method* or *handler*. It can use the **next()** function to pass the control to a middleware running after the response is sent out

Middleware

Middle functions can do the following:

- Execute any code
- Make changes to request or response object
- End the request-response cycle
- Call next in the stack, middleware or route method

```
var express = require('express')
var app = express()

var myLogger = function (req, res, next) {  // A middleware function
        console.log('LOGGED')
        next()
                    // Call next() so the request-response cycle does not stop here
}
app.use(myLogger) // It will be called before the route method

app.get('/', function (req, res) {

        res.send('Hello World!')
})
app.listen(3000)
```

Middleware Control Flow

- app.use() mounts a middleware function(s) at the specified path (the default path is "/")
  - *app.use([path,] callback [,callback…])*
- In the previous example, we used *app.use()* to call the middleware *MyLogger* before the route method/handler
- The order of middleware loading is important: middleware functions that are loaded first are also executed first
- Middleware functions are executed sequentially (in the order they are declared)
- A middleware function that does not invoke a next() function will end the request-response cycle
- If the current middleware function does not end the request-response cycle, it must call the next() function, otherwise the request will be left hanging

Middleware – Exercise

What would be the output of the following code when the following request is sent?
http://localhost:3000/

```
var express = require('express')
var app = express()

var myLogger = function (req, res, next) {
        console.log('LOGGED')
        next()
}
app.get('/', function (req, res) {

        res.send('Hello World!')
})
app.use(myLogger)
app.listen(3000)
```

Middleware – Exercise

What would be the output of the following code when the following request is sent?
http://localhost:3000/

```
var express = require('express')
var app = express()

var myLogger = function (req, res, next) {
        console.log('LOGGED')
        next()
}
app.get('/', function (req, res) {

        res.send('Hello World!')
})
app.use(myLogger)
app.listen(3000)
```

This middleware function will not be called as it was loaded after the route method/handler. So, "LOGGED" will not be printed to the console

This route handler terminates the request-response cycle as it does not pass control to the next function

The order of middleware loading is important

Useful Middlewares

- Middlewares are commonly used for tasks like
  - Parsing POST body
  - Parsing cookies
  - Many others
- Many third party middlewares for common processing
  - E.g. body-parser module consists of a few middleware functions for parsing form data

https://expressjs.com/en/guide/using-middleware.html

Template Engine

- Template engine represents the view technology
  - Defines a template format to blend static content with processing logic
  - Translate the template file into proper HTML file
    - Running processing logic
    - Replacing variable with values
- Many template engines that can work with Express
  - EJS
  - PUG (previously called JADE)
  - Mustache
- As expected, the oldest/simplest template engine (EJS) support the format of embedding JavaScript code in HTML

EJS – Embedded JavaScript Template

- JavaScript code can be embedded nearly everywhere in an HTML file
  - The convention is very similar to early JSP
  - The control flow should be embedded with <% %>
  - Escaped output (expression) should be embedded with <%= %>
  - And others

- Example EJS

```
<% if (user) { %>
    <h2><%= user.name %></h2>
<% } %>
```

https://www.npmjs.com/package/ejs

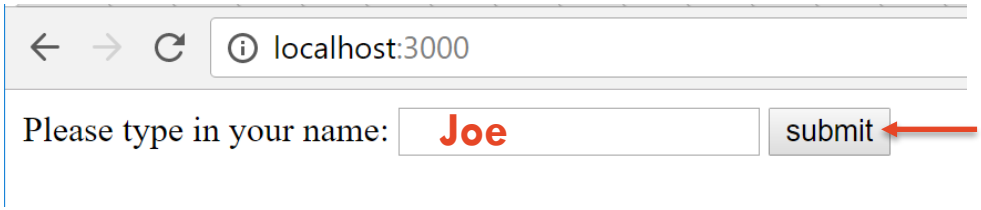
Simple Example – The Form

Greetingform.ejs

```
<!DOCTYPE html>
<html>
<head>
<meta charset="ISO-8859-1">
<title>Greetings Input</title>
</head>
<body>

<form method="GET" action = "greeting">
Please type in your name: <input type = "text" name="name" ></input>
<input type = "submit" value = "submit"></input>
</form>

</body>
</html>
```



Simple Example – Express App.

```
var express = require('express')
var path = require('path')

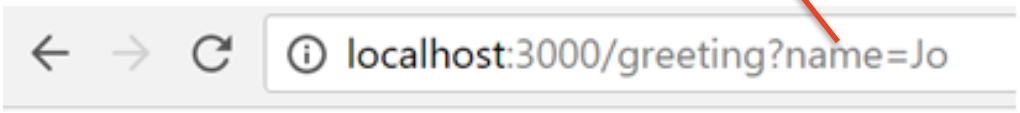
var app = express()
app.set('views', path.join(__dirname,'views'));
app.get('/', function(req,res){
     res.render('greetingform.ejs')
});
app.get('/greeting', function(req,res){
     name=req.query.name
     res.render('greeting.ejs', {name:name})
});

app.listen(3000, function () {
  console.log('greeting app listening on port 3000!')
})
```

By using use '__dirname', we make sure that the path is always relative to the current file instead of the current working directory (CWD).

The CWD may be different from the file directory if we run our application from another directory such as from one level up using 'node static/greeting.js' instead of the same directory—that is, 'node 1basic.js'. Relative path names such as './public' resolve relative to the CWD.

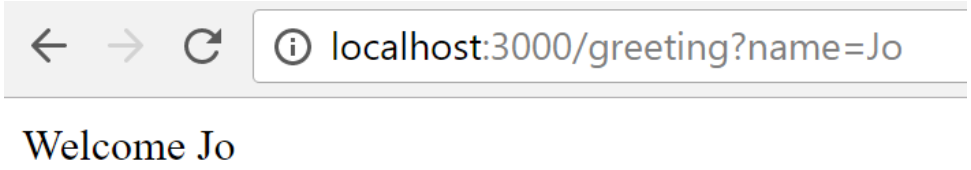
Using '__dirname', making it Independent of the CWD.



Simple Example – the response

greeting.ejs

```
<!DOCTYPE html>
<html>
  <head>
    <title>Customized Greeting!</title>
  </head>
  <body>
    Welcome <%= name %>
  </body>
</html>
```



Pug Template Engine

- Influenced by *Haml* and implemented with JavaScript for Node.js and browsers

- Pug defines simple rules for writing static HTML content together with processing logic
  - HTML tags
  - Attributes
  - Code and Control Structure
  - Interpolation

https://www.npmjs.com/package/pug

Pug – HTML Tags

- By default, text at the start of a line (or after only white space) represents an html tag

- Indented tags are nested, creating the tree like structure of html.

```
ul
  li Item A
  li Item B
  li Item C
```

```
<ul>
  <li>Item A</li>
  <li>Item B</li>
  <li>Item C</li>
</ul>
```

Pug – Attributes

- Attributes
  - Tag attributes look similar to html (with optional comma), but their values are just regular JavaScript.

```
a(href='google.com') Google
|
|
a(class='button' href='google.com') Google
|
|
a(class='button', href='google.com') Google
```

Using Pug

```
<a href="google.com">Google</a>
<a class="button" href="google.com">Google</a>
<a class="button" href="google.com">Google</a>
```

Using HTML

Pug - Simple Control

- Any JavaScript code can be included with a leading '-' character
- There are also first class conditional and iteration syntax

```
- for (var x = 0; x < 3; x++)
  li item
```

```
<li>item</li>
<li>item</li>
<li>item</li>
```

```
- var user = {description:'foo bar baz'}
- var authorised = false
div#user
  if user.description
    h2.green Description
    p.description= user.description
  else if authorised
    h2.blue Description
    p.description.
      User has no description,
      why not add one...
  else
    h2.red Description
    p.description User has no description
```

```
<div id="user">
  <h2
class="green">Description</h2
>
  <p class="description">foo
bar baz</p>
</div>
```

Pug – Interpolation

- JavaScript variables and expression can be included in various ways

```
- var title = "On Dogs: Man's Best Friend";
- var author = "enlore”;
- var theGreat = "<span>escape!</span>";
- var unescaped = "The tag <em> names </em> stays";

h1= title
p Written with love by #{author}
p This will be safe: #{theGreat}
P This is the unescaped example: !{unescaped}
```

```
<h1>On Dogs: Man's Best Friend</h1>
<p>Written with love by enlore</p>
<p>This will be safe: &lt;span&gt;escape!&lt;/span&gt;</p>
<p>This is the unescpaed example: The tag <em> names </em> stays</p>
```

Pug – Interpolation

- Inline tags
  - Inline tags, as opposite to block styled tags, do not start a new line.
  - PUG provides an easy way of writing them to avoid unnecessary indent

```
p
  This is a very long and boring paragraph that spans multiple
lines. Suddenly there is a #[strong strongly worded phrase] that
cannot be #[em ignored].
p
  And here's an example of an interpolated tag with an
attribute:#[q(lang="es") ¡Hola Mundo!]
```

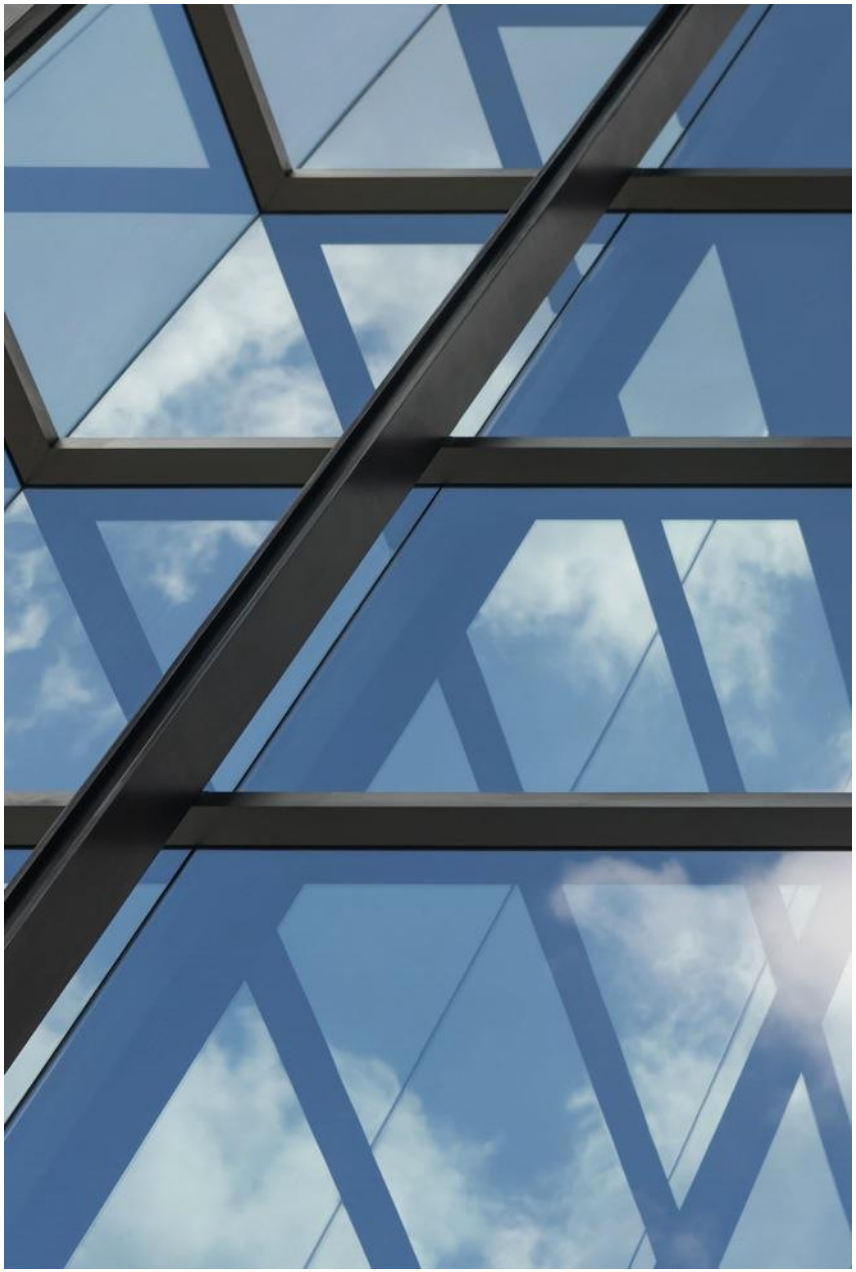
```
<p>This is a very long and boring paragraph that spans multiple lines.
Suddenly there is a <strong>strongly worded phrase</strong> that cannot
be <em>ignored</em>.</p>
<p>And here's an example of an interpolated tag with an attribute: <q
lang="es">¡Hola Mundo!</q></p>
```

Resources

- Randy Connolly, Ricardo Hoar, Fundamentals of Web Development, Global Edition, Pearson
- Rauch, Guillermo 2012, Smashing Node.js: JavaScript Everywhere,
  - e-book, accessible from USYD library, Chapter 7 HTTP
- Basarat Ali Syed 2014, Beginning Node.js
  - E-book, accessible from USYD library, Chapter 2 and 3
- Haviv, Amos Q, MEAN Web Development
  - E-book, accessible from USYD library, Chapter 2 and 3

W5 Tutorial: Node/Express Application

Week 6: MVC and Session Management NoSQL Database



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