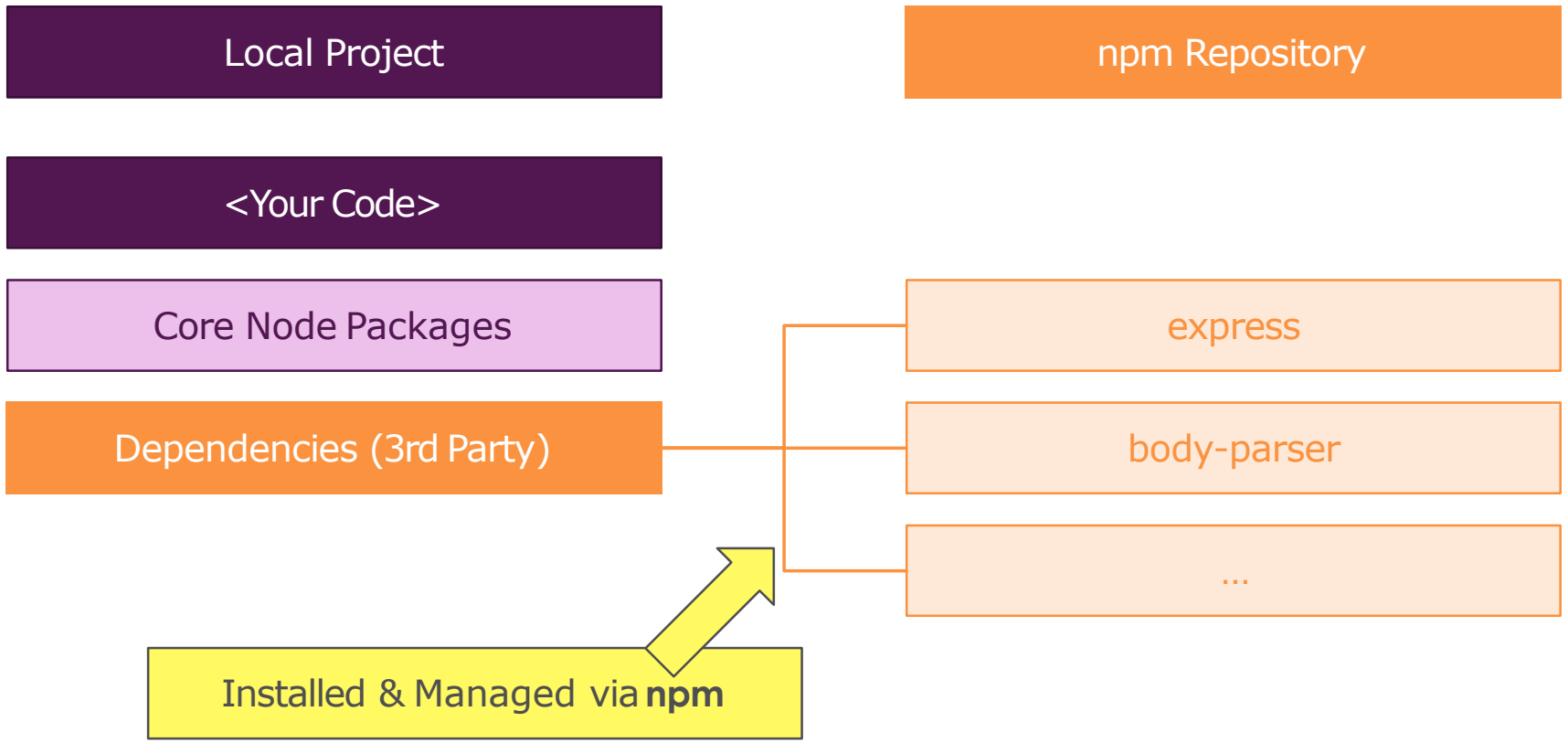
NPM & Modules

npm & packages Intro



What is npm?

- **npm** is a node package manager for Node.js packages, or modules if you like.
- www.npmjs.com hosts thousands of free packages to download and use.
- The NPM program is installed on your computer when you install Node.js.

- When we install a package:
  - Notice dependencies changes in `package.json`
  - notice folder: `node_modules`
  - This structure separate our app code to the dependencies. Later when we share/deploy our application, there's no need to copy `node_modules`, run: `npm install` will read all dependencies and install them locally.

What is a Package?

- A package in Node.js contains all the files you need for a module.
- Modules are JavaScript libraries you can include in your project.

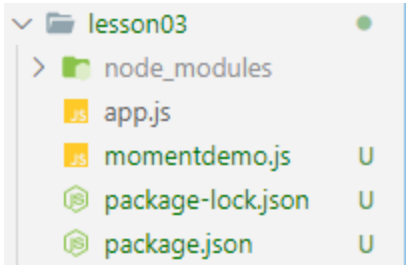
- A package contains:
  - JS files
  - package.json (manifest)
  - package-lock.json (maybe)

npm CLI Commands

```
npm -v // will print npm version
npm init // will create package.json
npm install <package> --S // download & install the code from last commit of git repo
                          // "--save" option will update package.json automatically
                          // other options are: --save-dev (-D) --save-optional (-O)
npm i <package> -g  // download & install a package globally
npm i <package> --dry-run
npm ls -g --depth=0 // show all global packages in your system
npm update // check versions in package.json and update
npm i npm -g // update npm
npm outdated -g // show all outdated global packages
npm prune // if a package is installed without --save then delete and clean

npm config list l // display the default npm settings
npm config set init-author-name "Josh Edward"
npm config delete init-author-name
npm config set save true // automatically --save (-S)

npm search lint // search online for package with lint in the name
npm home <package> // open browser to package homepage
npm repo <package> // open browser to package repository
```

Create & use a new package

```
npm init //follow the instruction to set up your project
npm install moment --save
// moment is a package that parse, validate, manipulate and display dates
```

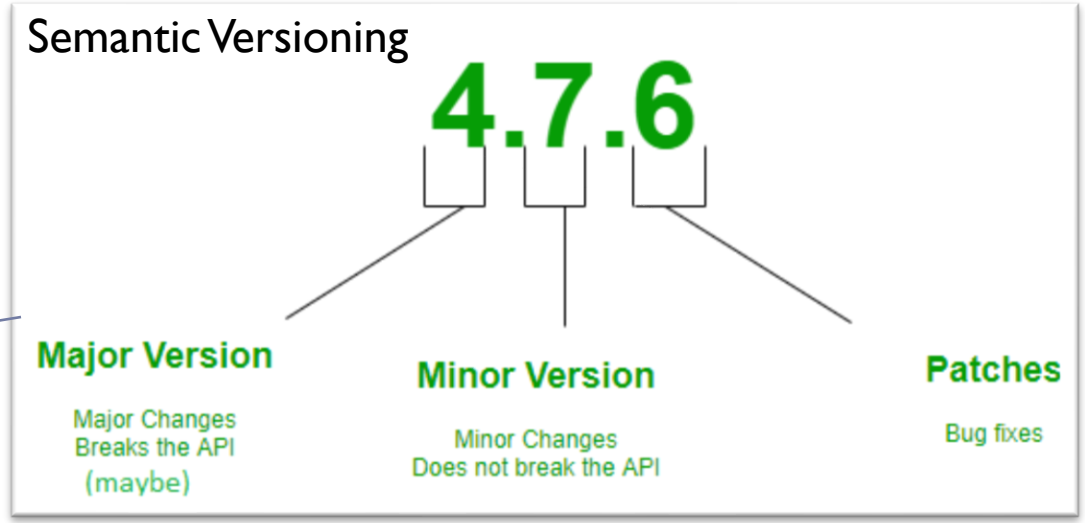


momentdemo.js

```
const moment = require('moment');
console.log(moment().format("ddd, hA")); // Mon, 10AM
```

package.json Manifest

```
{
  "name": "lesson03-demo",
  "version": "1.0.0",
  "description": "lesson 3 demos",
  "main": "app.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "Rujuan Xing",
  "license": "ISC",
  "dependencies": {
    "moment": "^2.24.0"
  }
}

// "scripts" defines commands we can run using (npm run commandName)
// ^ in version means it's ok to automatically update to anything
     within this major release
// ~ means only update patches. Not even minor updates
```



package-lock.json

- Introduced by NPM version 5 to capture the exact dependency tree installed at any point in time.
- Describes the exact tree
- Guarantee the dependencies on all environments.
- Use `npm ci` if you want to use dependencies in package-lock.json file
- Don't modify this file manually.
- Always use npm CLI to change dependencies, it'll automatically update package-lock.json


```
{
  "name": "lesson03-demo",
  "version": "1.0.0",
  "lockfileVersion": 1,
  "requires": true,
  "dependencies": {
    "moment": {
      "version": "2.24.0",
      "resolved": "https://registry.npmjs.org/moment/-/moment-2.24.0.tgz",
      "integrity": "sha512-bV7f+6l2QigeBBZSM/6yTNq4P2fNpSWj/0e7jQcy87A8e7o2nAfP/34/2ky5Vw4B9S446EtIhodAzkFCcR4dQg=="
    }
  }
}
```

Recall: Create a Node Server

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

const server = http.createServer((req, res) => {
    console.log(req);
    // process.exit();  //typically you don't do this.
});

server.listen(3000);
```

Understanding Request & Response

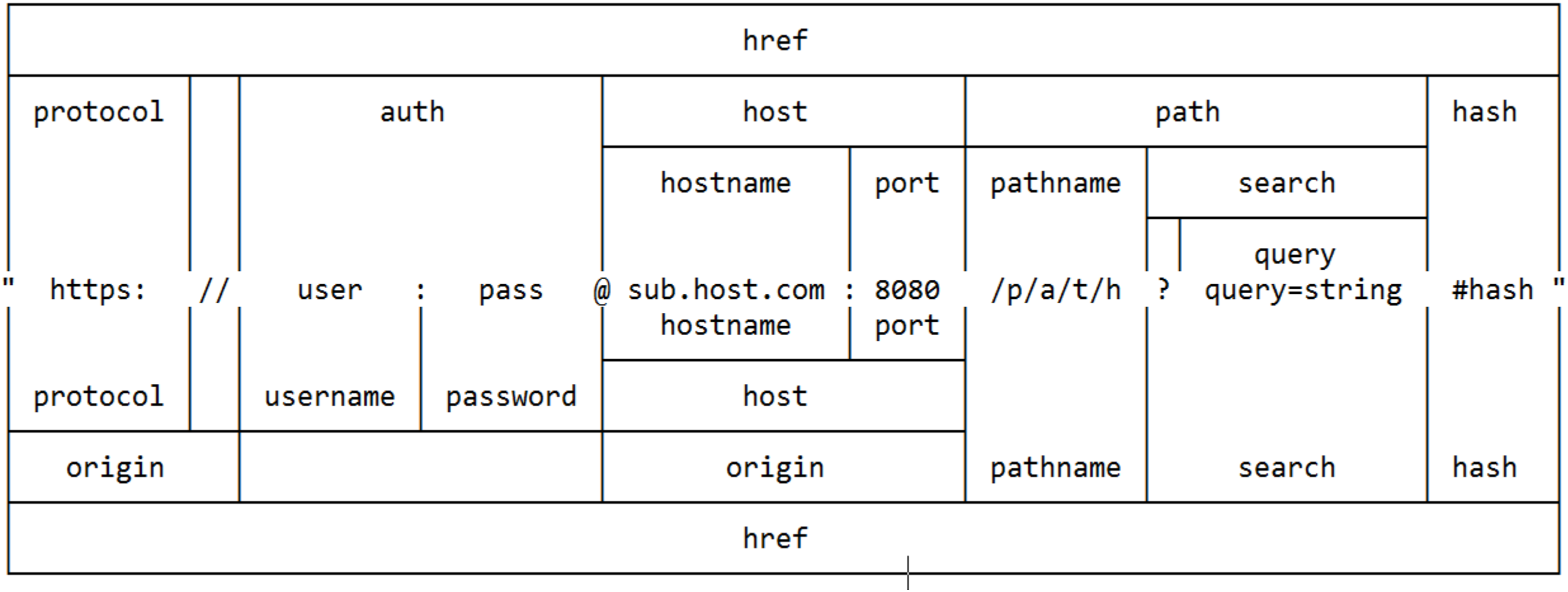
- A request message from a client to a server includes, within the first line of that message, the method to be applied to the resource, the identifier of the resource, and the protocol version in use.
- After receiving and interpreting a request message, a server responds with an HTTP response message.

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

const server = http.createServer((req, res) => {
    console.log(req.url, req.method, req.headers);

    res.setHeader('Content-Type', 'text/html');
    res.write('<html>');
    res.write('<head><title>My First Page</title></head>');
    res.write('<body><h1>Hellow from Node.js</h1></body>');
    res.write('</html>');
    res.end();

    // process.exit();  //typically you don't do this.
});

server.listen(3000);
```

HTTP Request: Reading Get and Post Data

- Handling basic GET & POST requests is relatively simple with Node.js.
- We use the `url` module to parse and read information from the URL.
- The `url` module uses the WHATWG URL Standard (https://url.spec.whatwg.org/)

Elements in URL Object



Using URL Module

- `url.parse(str)` will return URL object with properties (protocol, hostname, port, pathname, hash, etc...)

```
const url = require('url');
const myURL = url.parse('https://user:pass@sub.host.com:8080/p/a/t/h?course1=nodejs&course2=angular#hash');
console.log(myURL);
```

```
Url {
  protocol: 'https:',
  slashes: true,
  auth: 'user:pass',
  host: 'sub.host.com:8080',
  port: '8080',
  hostname: 'sub.host.com',
  hash: '#hash',
  search: '?course1=nodejs&course2=angular',
  query: 'course1=nodejs&course2=angular',
  pathname: '/p/a/t/h',
  path: '/p/a/t/h?course1=nodejs&course2=angular',
  href: 'https://user:pass@sub.host.com:8080/p/a/t/h?course1=nodejs&course2=angular#hash'
}
```

Parsing the Query String

```
const url = require('url');
const myURL2 = url.parse('https://user:pass@sub.host.com:8080/p/a/t/h?course1=nodejs&course2=angular#hash', true);
console.log(myURL2);
```

```
Url {
  protocol: 'https:',
  slashes: true,
  auth: 'user:pass',
  host: 'sub.host.com:8080',
  port: '8080',
  hostname: 'sub.host.com',
  hash: '#hash',
  search: '?course1=nodejs&course2=angular',
  query: [Object: null prototype] { course1: 'nodejs', course2: 'angular' },
  pathname: '/p/a/t/h',
  path: '/p/a/t/h?course1=nodejs&course2=angular',
  href: 'https://user:pass@sub.host.com:8080/p/a/t/h?course1=nodejs&course2=angular#hash'
}
```

Format a URL

```
const urlObject = {
      protocol: 'http',
      host: 'www.mim.edu',
      search: '?q=cs',
      pathname: '/search', };

console.log( url.format(urlObject) );
// http://www.mim.edu/search?q=CS
```

Using querystring module

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

const result1 = querystring.stringify({
    firstname: 'Josh',
    lastname: 'Edward'
})
console.log(result1); //firstname=Josh&lastname=Edward

const result2 = querystring.parse('firstname=Josh&lastname=Edward');
console.log(result2);// {firstname: 'Josh', lastname: 'Edward'}
```

HTTP Request: Reading Post Data

- Handling POST data is done in a **non-blocking way**, by using asynchronous callbacks. Because POST requests can potentially be very large - multiple megabytes in size. Handling the whole bulk of data in one go would result in a blocking operation.
- To make the whole process non-blocking, Node.js serves our code the POST data in small chunks (**stream**), callbacks that are called upon certain events. These events are `data` (a new chunk of POST data arrives) and `end` (all chunks have been received).
- We need to tell Node.js which functions to call back to when these events occur. This is done by adding listeners to the `request` object

Reading Post Data Example

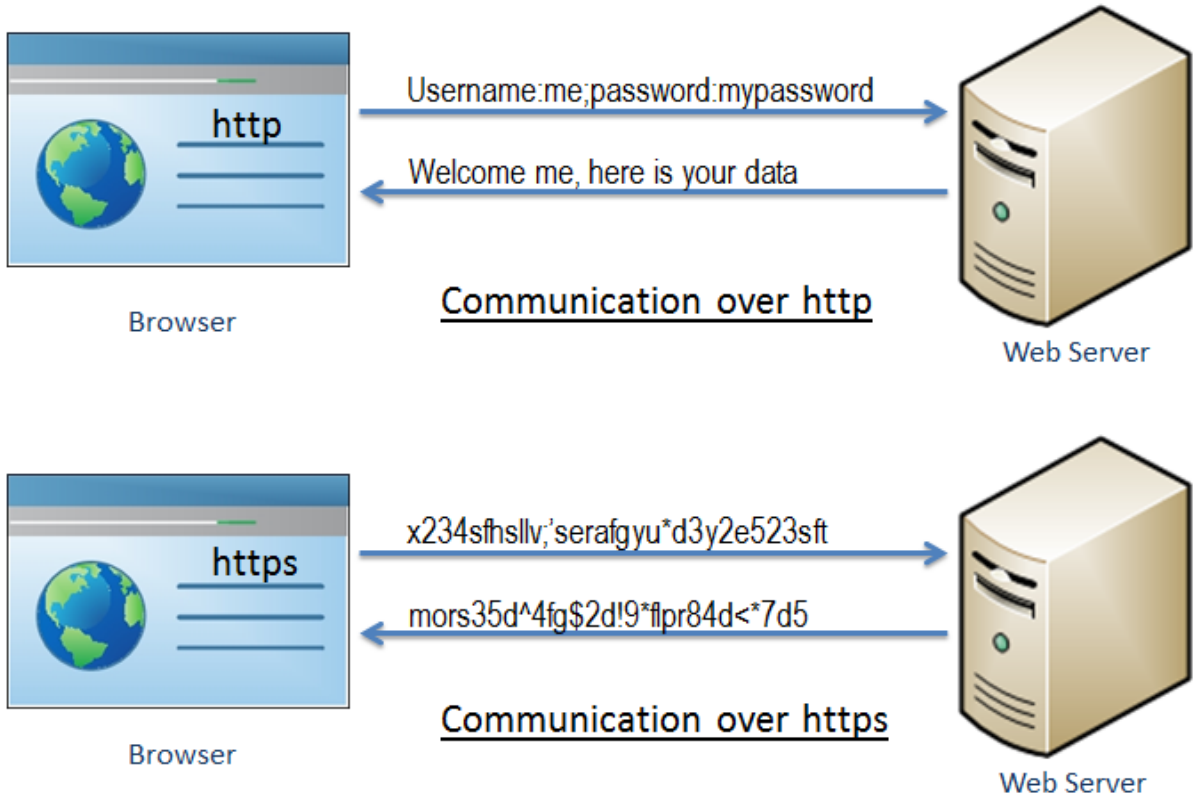
```
const server = http.createServer((req, res) => {
    // console.log(req.url, req.method, req.headers);
    const url = req.url;
    const method = req.method;

    if (url === '/') {
        res.write('<html>');
        res.write('<head><title>Enter Message</title></head>');
        res.write('<body><form action="/messsage" method="POST">Enter Message: <input name="message"><button type="submit">Send</button></for
m></body>');
        res.write('</html>');
        return res.end(); // "retrun" here exits the function execution, otherwise continue.
    }

    if (url === '/messsage' && method === 'POST') {
        const body = [];
        req.on('data', (chunk) => {
            body.push(chunk);
        });
        req.on('end', () => {
            const parsedBody = Buffer.concat(body).toString();
            console.log(parsedBody);
        });
        return res.end('Done');
    }
});
```

Routing Requests

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

http.createServer(function(req, res) {
	if (req.url === '/') {
		fs.createReadStream(__dirname + '/index.htm').pipe(res);
	} else if (req.url === '/api') {
		res.writeHead(200, { 'Content-Type': 'application/json' });
		var obj = { firstname: 'Josh', lastname: 'Edward' };
		res.end(JSON.stringify(obj));
	} else {
		res.writeHead(404);
		res.end();
	}
}).listen(1337, '127.0.0.1');
```

HTTPS and Secure Communication

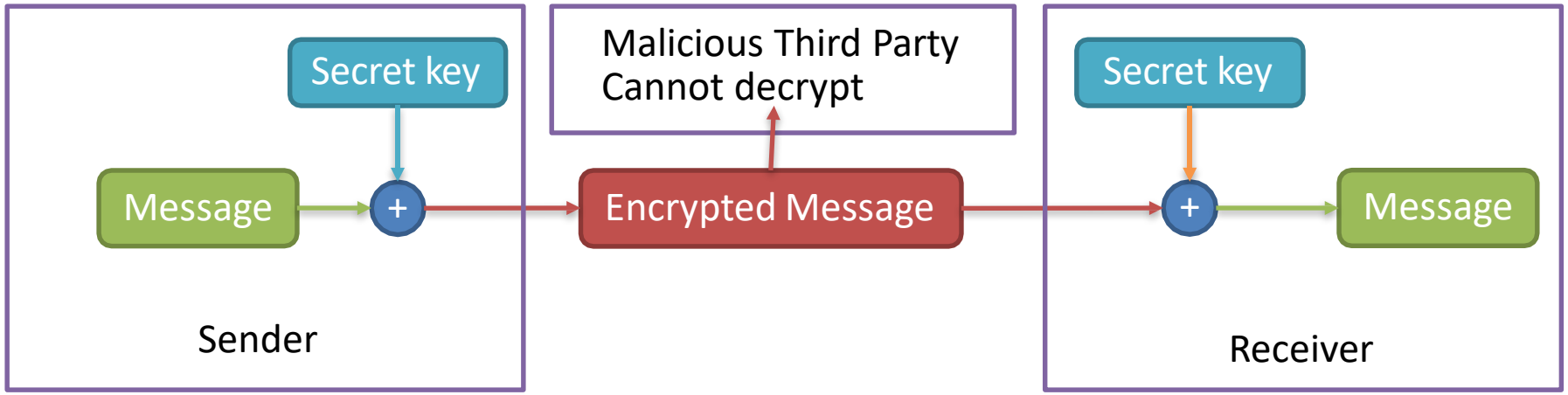
- HTTPS stands for Hyper Text Transfer Protocol Secure. It is a protocol for securing the communication between two systems e.g. the browser and the web server.
- The following figure illustrates the difference between communication over http and https:



https://www.tutorialsteacher.com/https/what-is-https

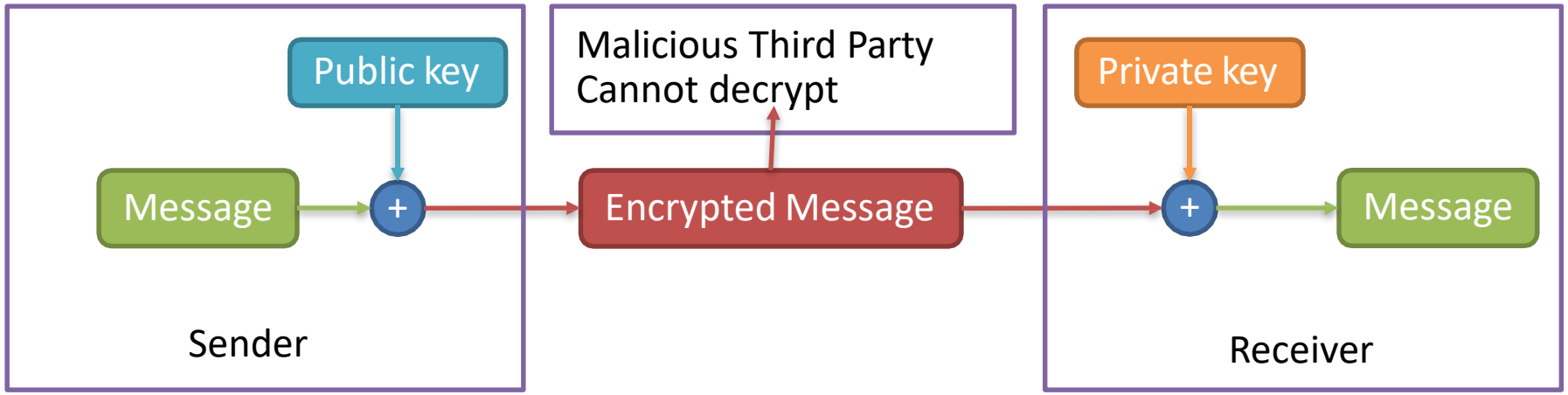
Symmetric Key Cryptography

- Symmetric Encryption
  - Shared secret key between the two parties



Public Key Cryptography

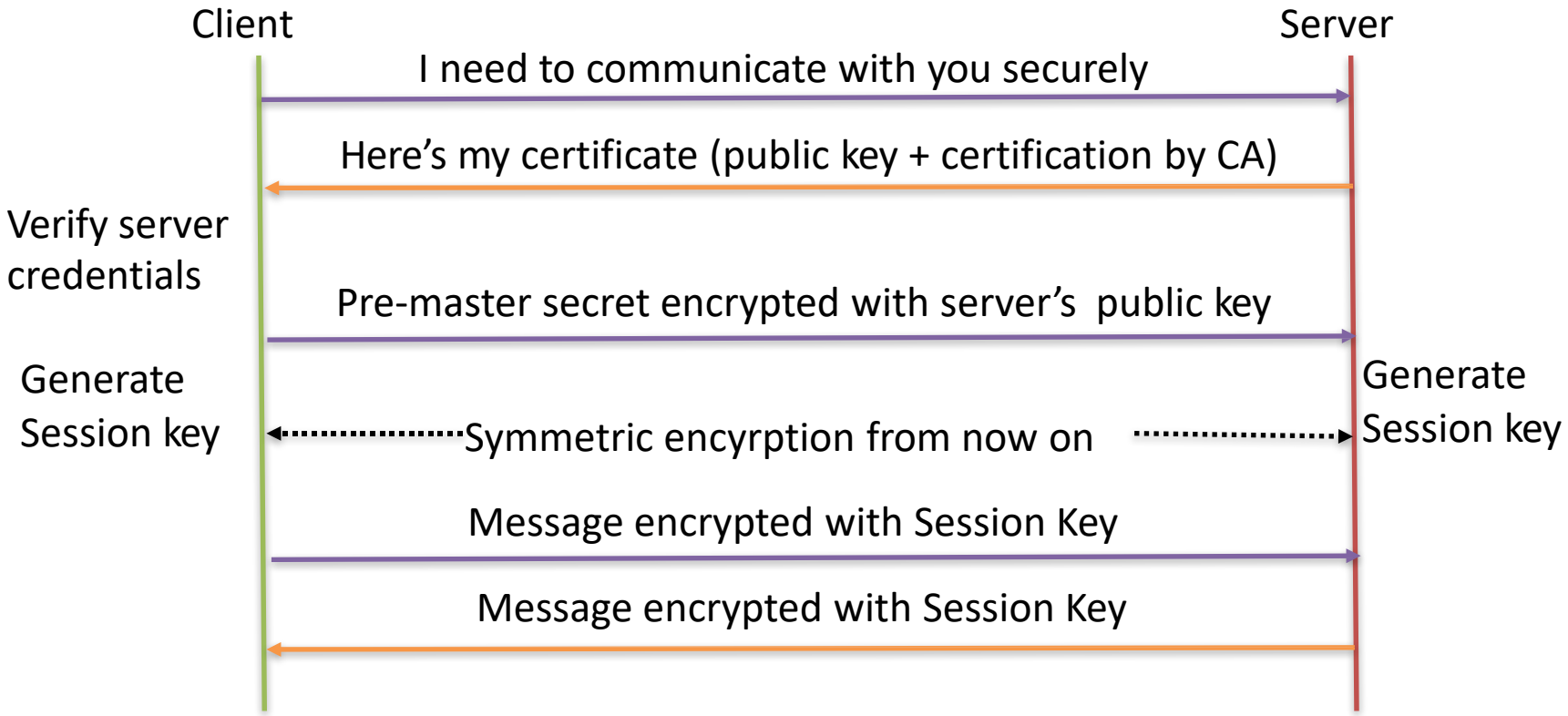
- Asymmetric Encryption
  - Public key that can be widely distributed
  - Private key that is only known to the receiver



Secure Sockets Layer (SSL) / Transport Layer Security (TLS)

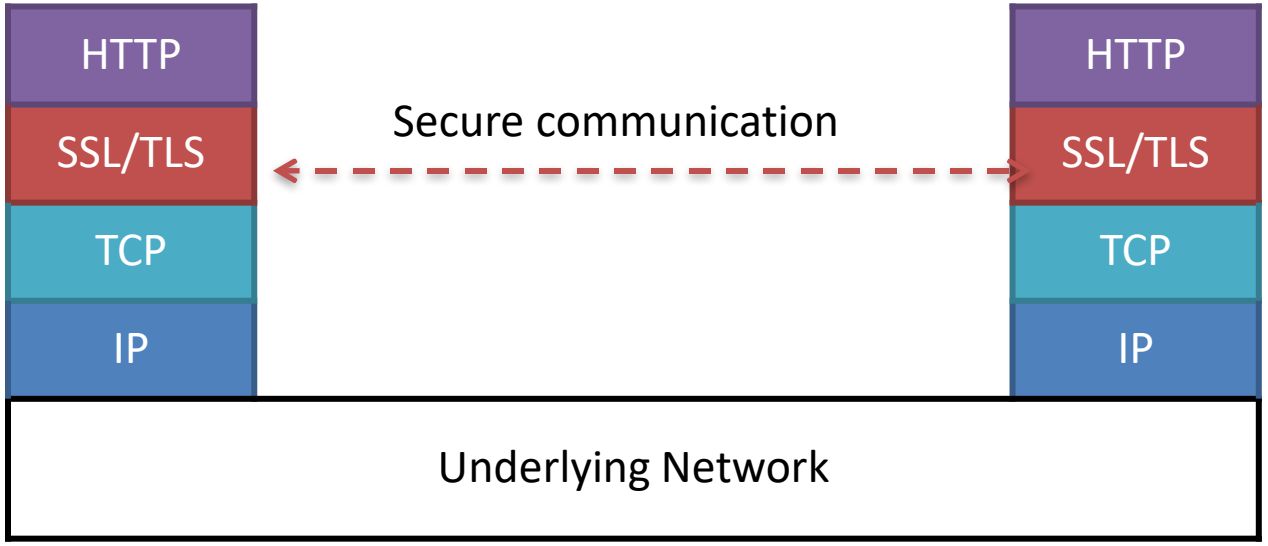
- Cryptographic protocols that enable secure communication over an insecure network like the Internet
- Privacy and Integrity of the communication protected
  - Uses a combination of public-key crytography and symmetric cryptography

SSL/TLS Handshake



https://www.ssl.com/article/ssl-tls-handshake-overview/

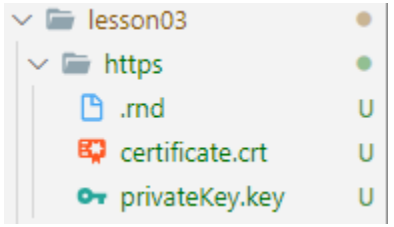
HTTPS


HTTP
SSL/TLS
TCP
IP
Secure communication
HTTP
SSL/TLS
TCP
IP
Underlying Network

Generating Keys

- OpenSSL Windows installer is here http://slproweb.com/products/Win32OpenSSL.html
- Navigate to the OpenSSL bin directory.
  - C:\openssl_X64\bin in our example. You can also add openssl.exe as Path environment variable, then you can use command "openssl" under all direcotries.
- Right-click the **openssl.exe** file and select **Run as administrator**.
- Enter the following command to begin generating a certificate and private key:
  - **req -x509 -sha256 -nodes -days 365 -newkey rsa:2048 -keyout privateKey.key -out certificate.crt**

```
OpenSSL> req -x509 -sha256 -nodes -days 365 -newkey rsa:2048 -keyout privateKey.key -out certificate.crt
Loading 'screen' into random state - done
Generating a 2048 bit RSA private key
.....................................+++
.........+++
writing new private key to 'privateKey.key'
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:US
State or Province Name (full name) [Some-State]:Iowa
Locality Name (eg, city) []:Fairfield
Organization Name (eg, company) [Internet Widgits Pty Ltd]:MIU
Organizational Unit Name (eg, section) []:MSD
Common Name (eg, YOUR name) []:Rujuan Xing
Email Address []:rxing@miu.edu
```



- For production environment / deploying to a production server you need to get the keys and certificate from a certification authority (CA) e.g., Verisign, Thawte

  https://helpcenter.gsx.com/hc/en-us/articles/115015960428-How-to-Generate-a-Self-Signed-Certificate-and-Private-Key-using-OpenSSL

Create HTTPS Server

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

var options = {
    key: fs.readFileSync('./privateKey.key'),
    cert: fs.readFileSync('./certificate.crt')
};

const server = require('https')
    .createServer(options);

server.on('request', (req, res) => {
    res.writeHead(200, { 'content-type': 'text/plain' });
    res.end('Hello from my HTTPS Web server!!!\n');
});

server.listen(443);
```

Try this link if the previous slides doesn't work for you: https://nodejs.org/en/knowledge/HTTP/servers/how-to-create-a-HTTPS-server/

Resources

- Node and NPM
  - Nodejs.org
  - Npmjs.com
  - Node API Documentation
  - NPM Documentation

- HTTPS
  - HTTPS (Wikipedia)
  - Public Key Cryptography
  - Transport Layer Security
  - Node HTTPS Server
  - Kurose, James F., and Keith W. Ross. Computer networking: a top-down approach. Pearson, 2017, ISBN-10: 0134522206 • ISBN-13: 9780134522203.

- Other Resources
  - Howto: Make Your Own Cert With OpenSSL on Windows
  - OpenSSL for Windows
  - How to Use SSL/TLS with Node.js
  - Adding HTTPS (SSL) to Express 4.X Applications
  - How does HTTPS actually work?

Homework

- Create a https server which is listen to 3000 port. The home page "/" which displays an html page which one input to enter any text message, after click "Submit" button, the user's inputs are stored in a local file on the server side. User will be redirect to home page after saving successfully.