Lecture 09

presentation

DAD – Distributed Applications Development

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Cristian Toma – Business Card

Agenda for Lecture 09

Java Script: CallBack Functions and Async Programming, Buffers, Promise, Event-Emitter, node.js modules

ECMAScript/node.js Overview

About node.js …

- Created by Ryan Dahl in 2009
- Development && maintenance sponsored by Joyent
- License: MIT
- Latest LTS Version (Y2020): 12.16.1 (includes npm 6.13.4)
- The syntax is compliant with Java Script / ECMAScript 2015+
- Based on Google V8 Engine
- +100 000 packages
- it has interpreter on x86, ARM, ESP8266, etc. controllers, on various OS-es: MacOS, Linux, Windows, Linux Embedded, etc.

https://nodejs.org | https://nodejs.org/en/download/

https://www.slideshare.net/bewithjitendrapatel/introduction-to-nodejs-aka-nodejs

Other projects as complementary to node.js …

- Vert.x => Polygot programming
- Akka => Scala and Java/Kotlin
- Tornado => Python
- Libevent => C
- EventMachine => Ruby

Node.js is not…

- Another Web framework
- For beginners
- Supporting Multi-thread

https://www.slideshare.net/bewithjitendrapatel/introduction-to-nodejs-aka-nodejs

1. node.js Intro / RECAP

Development of Server-side for the Web & others …

Traditional desktop applications have a user interface wired up with background logic

- user interfaces are based on Windows Forms, Jswing, WPF, Gtk, Qt, etc. and dependant on operating system

• On the web user interfaces are standardized

- HTML for markup
- CSS for style
- JavaScript for dynamic content

• In the past proprietary technologies existed on the web, e.g. Adobe Flash, ActiveX: They are slowly dying …

Server Side technologies include: **Java Servlet/JSP**, PHP, ASP .NET, Rails, Django, and: **node.js**

https://www.slideshare.net/bewithjitendrapatel/introduction-to-nodejs-aka-nodejs

1. node.js Intro / RECAP

Why node.js?

- Non Blocking I/O
- V8 Java-Script Engine
- Single Thread with Event Loop
- 40,000+ modules
- 1 Language for Frontend and Backend
- Active community

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1. node.js Intro / RECAP

What is node.js?

« A platform built on Chrome's JavaScript runtime for easily building fast, scalable network applications. » http://nodejs.org/

- Asynchronous I/O framework
- Core in C++ on top of v8
- Rest of it, in JavaScript / ECMAScript
- Swiss army knife for network Related stuffs
- Can handle thousands of Concurrent connections with Minimal overhead (CPU/Memory) on a single process
- It's NOT a web framework, and it's also NOT a language
- It is a development platform basing on interpreting JavaScript / ECMAScript code in native C/C++

https://www.slideshare.net/bewithjitendrapatel/introduction-to-nodejs-aka-nodejs

1. node.js Intro / RECAP

Why JavaScript/ECMAScript?

- Friendly call-backs
- Ubiquitous
- No I/o Primitives
- One language to RULE them all

JavaScript is well known for client-side scripts running inside the browser

node.js is JavaScript running on the server-side

SSJS -> Server-Side JavaScript

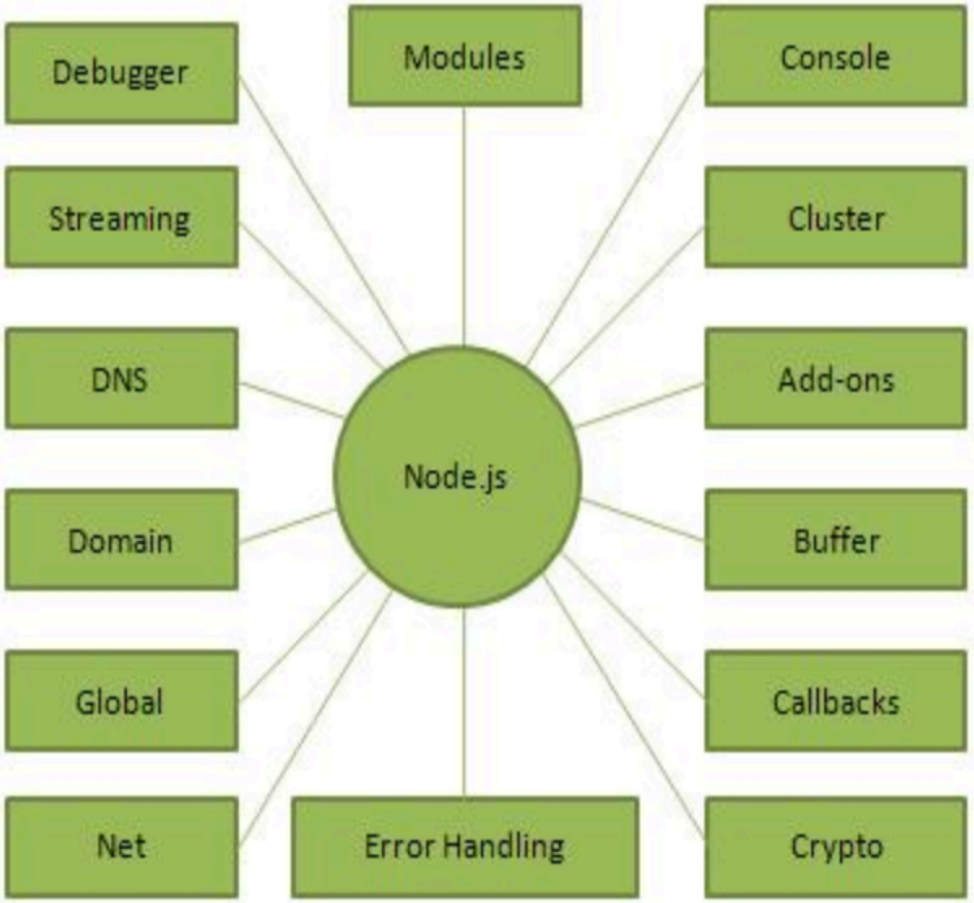
Use a language you know

Use the same language for client side and server side

https://www.slideshare.net/bewithjitendrapatel/introduction-to-nodejs-aka-nodejs

Concepts

The following diagram depicts some important parts of Node.js which we will discuss in detail in the subsequent chapters.

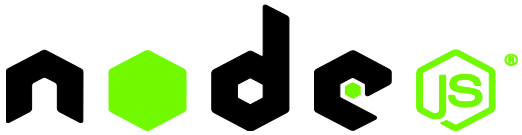


JavaScript Engines……

Every browser has **its own VM**

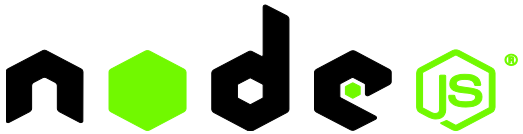
Firefox? **Spidermonkey**
Internet Explorer? **Chakra**
Chrome? **V8**
Safari? **JavaScriptCore**
Opera? **Carakan**

Also **Rhino**, stand alone



- In simple words Node.js is **'server-side JavaScript'**.
- In *not-so-simple* words Node.js is a high-performance **network applications framework**, well optimized for high concurrent environments.
- It's a **command line** tool.
- In 'Node.js' , '**.js**' doesn't mean that its solely written JavaScript. It is 40% JS and 60% C++.
- From the official site:

'Node's goal is to provide an easy way to build scalable network programs' - (from nodejs.org!)



https://www.slideshare.net/vikasing/introduction-to-nodejs-11730771

Introduction: Advanced (& Confusing)

- Node.js uses an **event-driven**, **non-blocking I/O** model, which makes it lightweight. (from nodejs.org!)
- It makes use of **event-loops** via JavaScript's **callback** functionality to implement the non-blocking I/O.
- Programs for Node.js are written in JavaScript but not in the same JavaScript we are use to. There is no DOM implementation provided by Node.js, i.e. you **can not** do this:

```
var element = document.getElementById("elementId");
```

- Everything inside Node.js runs in a **single-thread**.

https://www.slideshare.net/vikasing/introduction-to-nodejs-11730771

EXAMPLE-1: GETTING STARTED & HELLO WORLD

- Install/build Node.js.
  - (Yes! Windows installer is available!)
- Open your favorite editor and start typing JavaScript.
- When you are done, open cmd/terminal and type this:

  `'node YOUR_FILE.js'`

- Here is a simple example, which prints '*hello world*'

```
var sys = require("sys");
setTimeout(function(){
sys.puts("world");},3000);
sys.puts("hello");
//it prints 'hello' first and waits for 3 seconds and then
  prints 'world'
```

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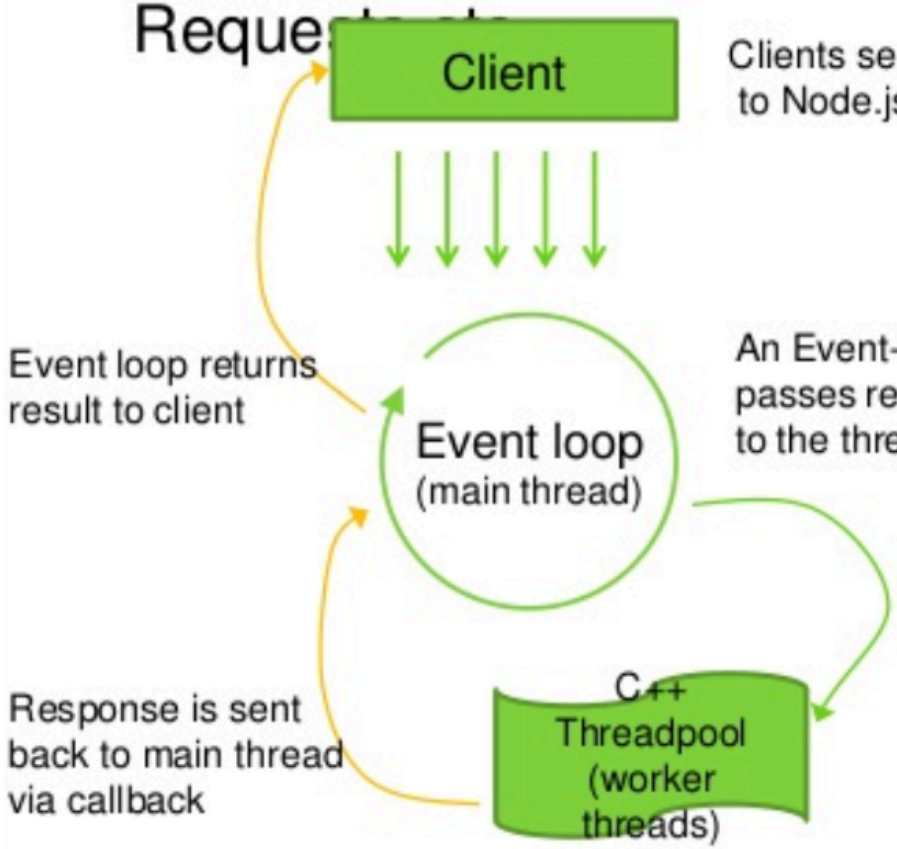
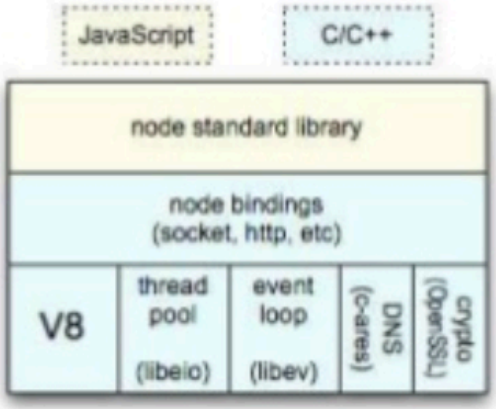
SOME THEORY: EVENT-LOOPS

- Event-loops are the core of event-driven programming, almost all the UI programs use event-loops to track the user event, for example: Clicks, Ajax Reque





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The idea behind node.js....

- Perform asynchronous processing on single thread instead of classical multithread processing, minimize overhead & latency, maximize scalability
- Scale horizontally instead of vertically
- Ideal for applications that serve a lot of requests but dont use/need lots of computational power per request
- Not so ideal for heavy calculations, e.g. massive parallel computing
- Also: Less problems with concurrency

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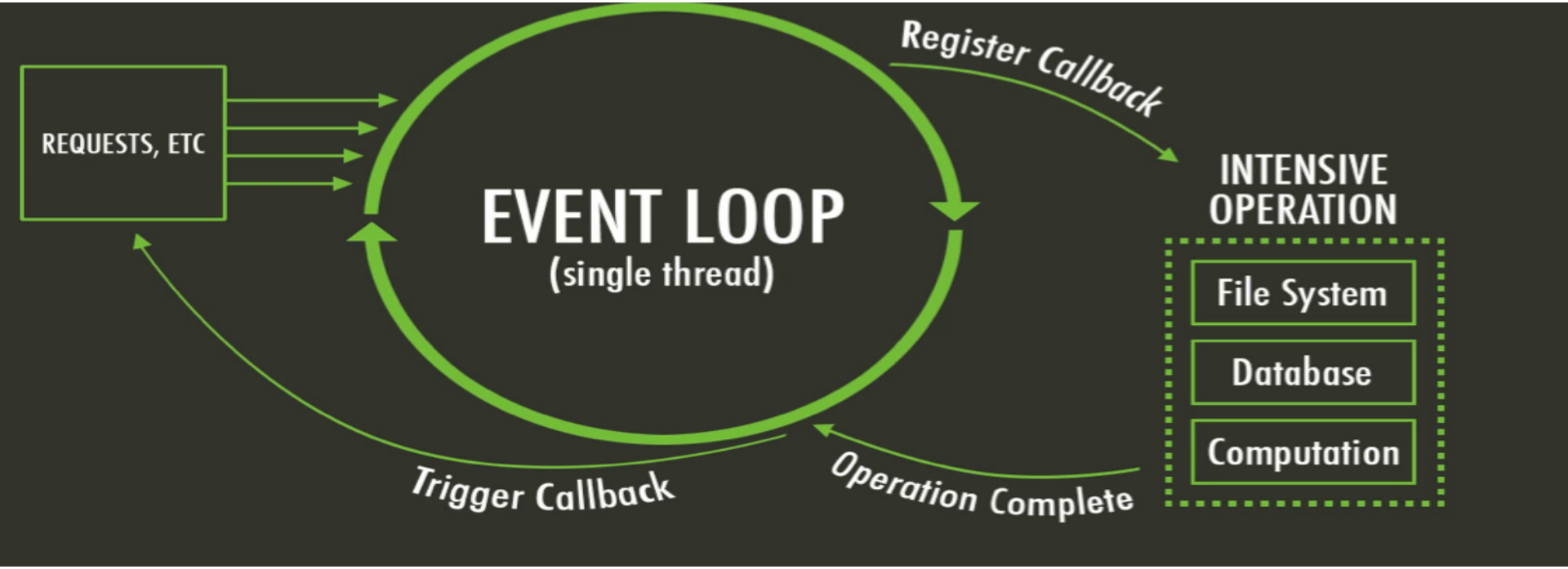
Node.js Event Loop



There are a couple of implications of this apparently very simple and basic model

- Avoid synchronous code at all costs because it blocks the event loop
- Which means: callbacks, callbacks, and more callbacks

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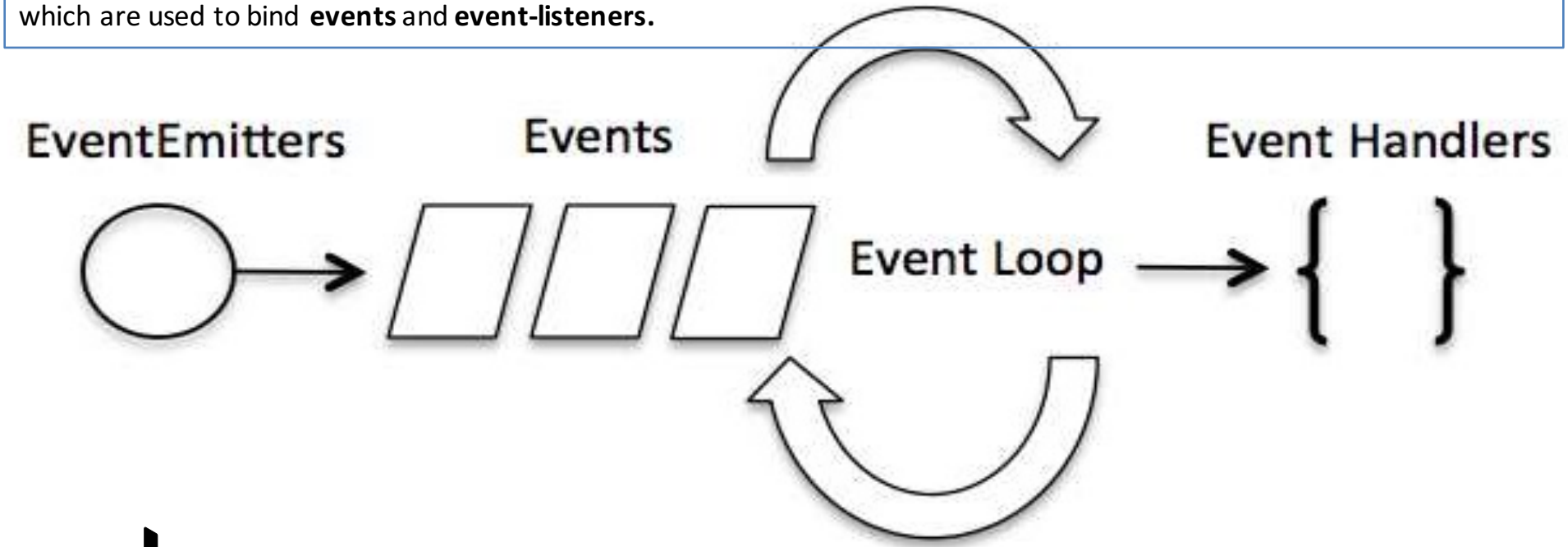
Node.js is a single-threaded application, but it can support concurrency via the concept of **event** and **callbacks**. Every API of Node.js is asynchronous and being single-threaded, they use **async function calls** to maintain concurrency. Node uses observer pattern. Node thread keeps an event loop and whenever a task gets completed, it fires the corresponding event which signals the event-listener function to execute.

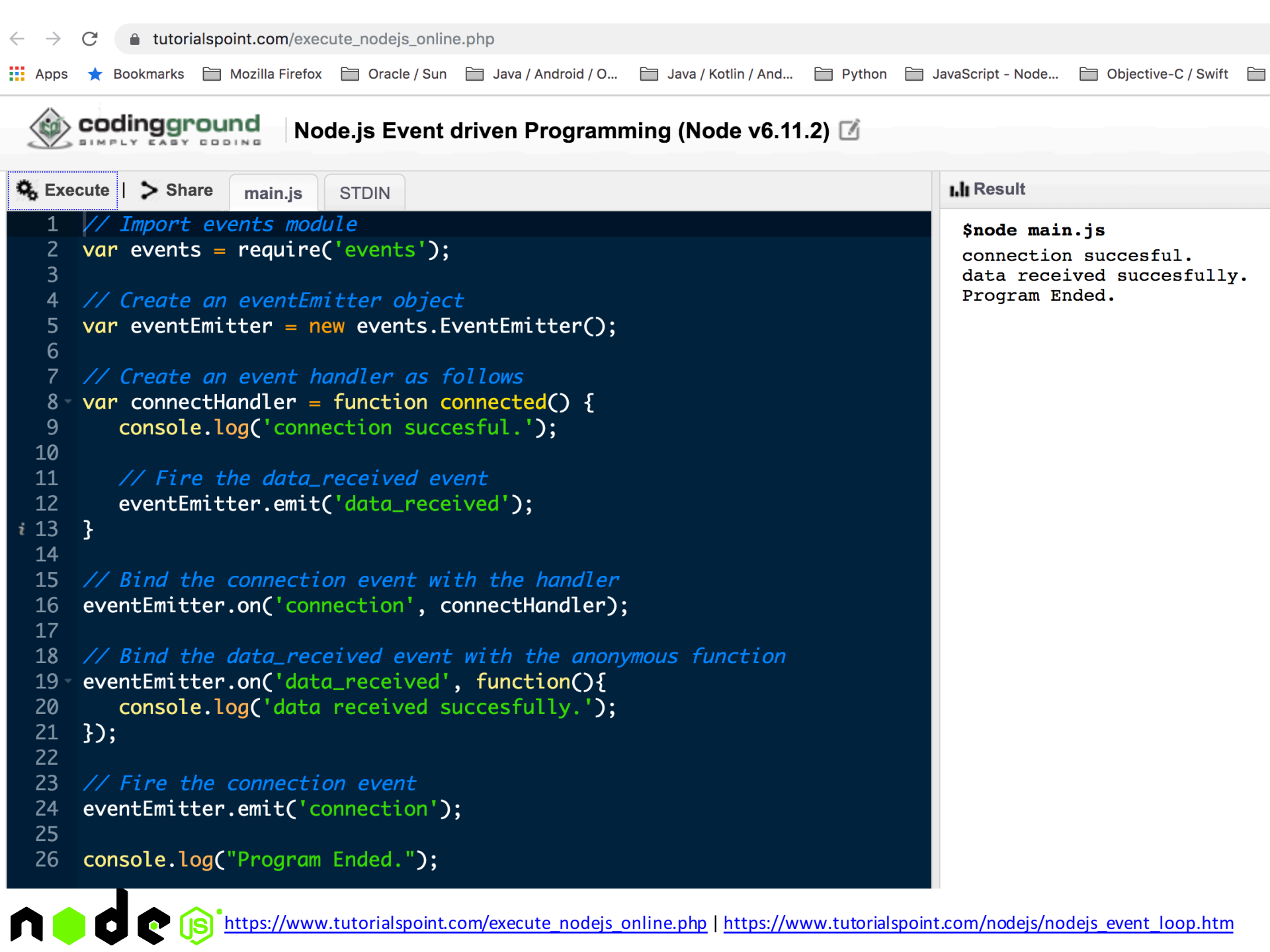
Event-Driven Programming

Node.js uses events heavily and it is also one of the reasons why Node.js is pretty fast compared to other similar technologies. As soon as Node starts its server, it simply initiates its variables, declares functions and then simply waits for the event to occur.

In an event-driven application, there is generally a main loop that listens for events, and then triggers a callback function when one of those events is detected. Although events look quite similar to callbacks, the difference lies in the fact that callback functions are called when an asynchronous function returns its result, whereas event handling works on the observer pattern. The functions that listen to events act as **Observers**. Whenever an event gets fired, its listener function starts executing. Node.js has multiple in-built events available through events module and **EventEmitter** class which are used to bind **events** and **event-listeners.**



https://www.tutorialspoint.com/execute_nodejs_online.php | https://www.tutorialspoint.com/nodejs/nodejs_event_loop.htm




```
1  // Import events module
2  var events = require('events');
3
4  // Create an eventEmitter object
5  var eventEmitter = new events.EventEmitter();
6
7  // Create an event handler as follows
8  var connectHandler = function connected() {
9     console.log('connection succesful.');
10
11    // Fire the data_received event
12    eventEmitter.emit('data_received');
13 }
14
15 // Bind the connection event with the handler
16 eventEmitter.on('connection', connectHandler);
17
18 // Bind the data_received event with the anonymous function
19 eventEmitter.on('data_received', function(){
20    console.log('data received succesfully.');
21 });
22
23 // Fire the connection event
24 eventEmitter.emit('connection');
25
26 console.log("Program Ended.");
```

Blocking vs Non-Blocking……

Example :: Read data from file and show data

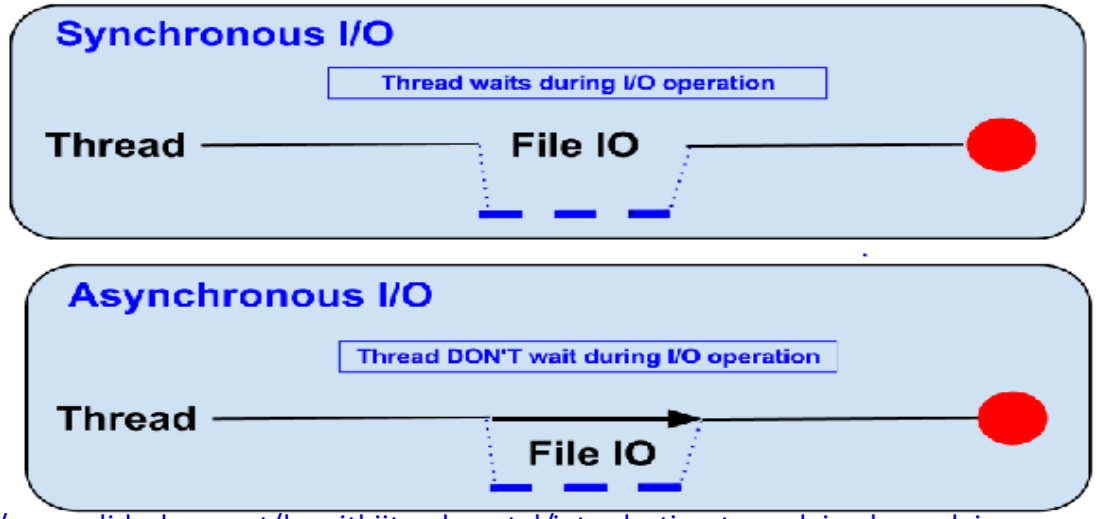
SOME THEORY: NON-BLOCKING I/O

- Traditional I/O

```
var result = db.query("select x from table_Y");
doSomethingWith(result); //wait for result!
doSomethingWithOutResult(); //execution is blocked!
```

- Non-traditional, Non-blocking I/O

```
db.query("select x from table_Y",function (result){
  doSomethingWith(result);
});
doSomethingWithOutResult();
  delay!
```



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Node.js for….

- Web application
- Web-socket server
- Ad server
- Proxy server
- Streaming server
- Fast file upload client
- Any Real-time data apps
- Anything with high I/O

Where to Use Node.js?

• Following are the areas where Node.js is proving itself as a perfect technology partner.

• I/O bound Applications

• Data Streaming Applications

• Data Intensive Real-time Applications (DIRT)

• JSON APIs based Applications

• Single Page Applications

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In NodeJS

Standard JavaScript with

- Buffer
- C/C++ Addons
- Child Processes
- Cluster
- Console
- Crypto
- Debugger
- DNS
- Domain
- Events
- File System
- Globals
- HTTP
- HTTPS
- Modules
- Net
- OS
- Path
- Process
- Punycode
- Query Strings
- Readline
- REPL
- Stream
- String Decoder
- Timers
- TLS/SSL
- TTY
- UDP/Datagram
- URL
- Utilities
- VM
- ZLIB

... but without DOM manipulation

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When to not use Node.js

- When you are doing heavy and CPU intensive calculations on server side, because event-loops are CPU hungry.
- Node.js API is still in beta, it keeps on changing a lot from one revision to another and there is a very little backward compatibility. Most of the packages are also unstable. Therefore is not yet production ready.
- Node.js is a no match for enterprise level application frameworks like Spring(java), Django(python), Symfony(php) etc. Applications written on such platforms are meant to be highly user interactive and involve complex business logic.

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- Read the free O'reilly Book *'Up and Running with Node.js'* @ http://ofps.oreilly.com/titles/9781449398583/
- Visit www.nodejs.org for Info/News about Node.js
- Watch Node.js tutorials @ http://nodetuts.com/
- For Info on MongoDB: http://www.mongodb.org/display/DOCS/Home
- For anything else **Google!**

Section Conclusion

Fact: **node.js is used in DAD**

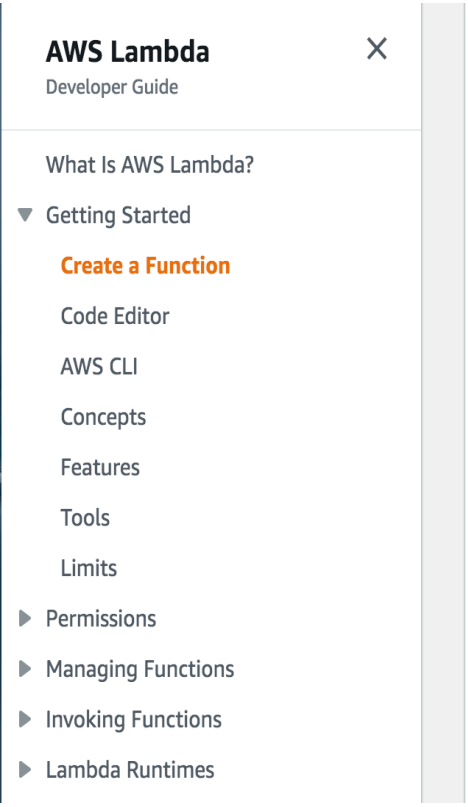
In few **samples** it is simple to remember: ECMAScript / JavaScript RECAP and node.js best practice for DAD / REST Services development and FaaS – Function as a Service implementation

FaaS: Function as a Service – Amazon AWS Lambda example

Server-less Development – FaaS: AWS Lambda

2. AWS Lambda – FaaS Cloud

https://docs.aws.amazon.com/lambda/latest/dg/getting-started-create-function.html



Create a Lambda Function with the Console

PDF | Kindle | RSS

In this Getting Started exercise you create a Lambda function using the AWS Lambda console. Next, you manually invoke the Lambda function using sample event data. AWS Lambda executes the Lambda function and returns results. You then verify execution results, including the logs that your Lambda function created and various CloudWatch metrics.

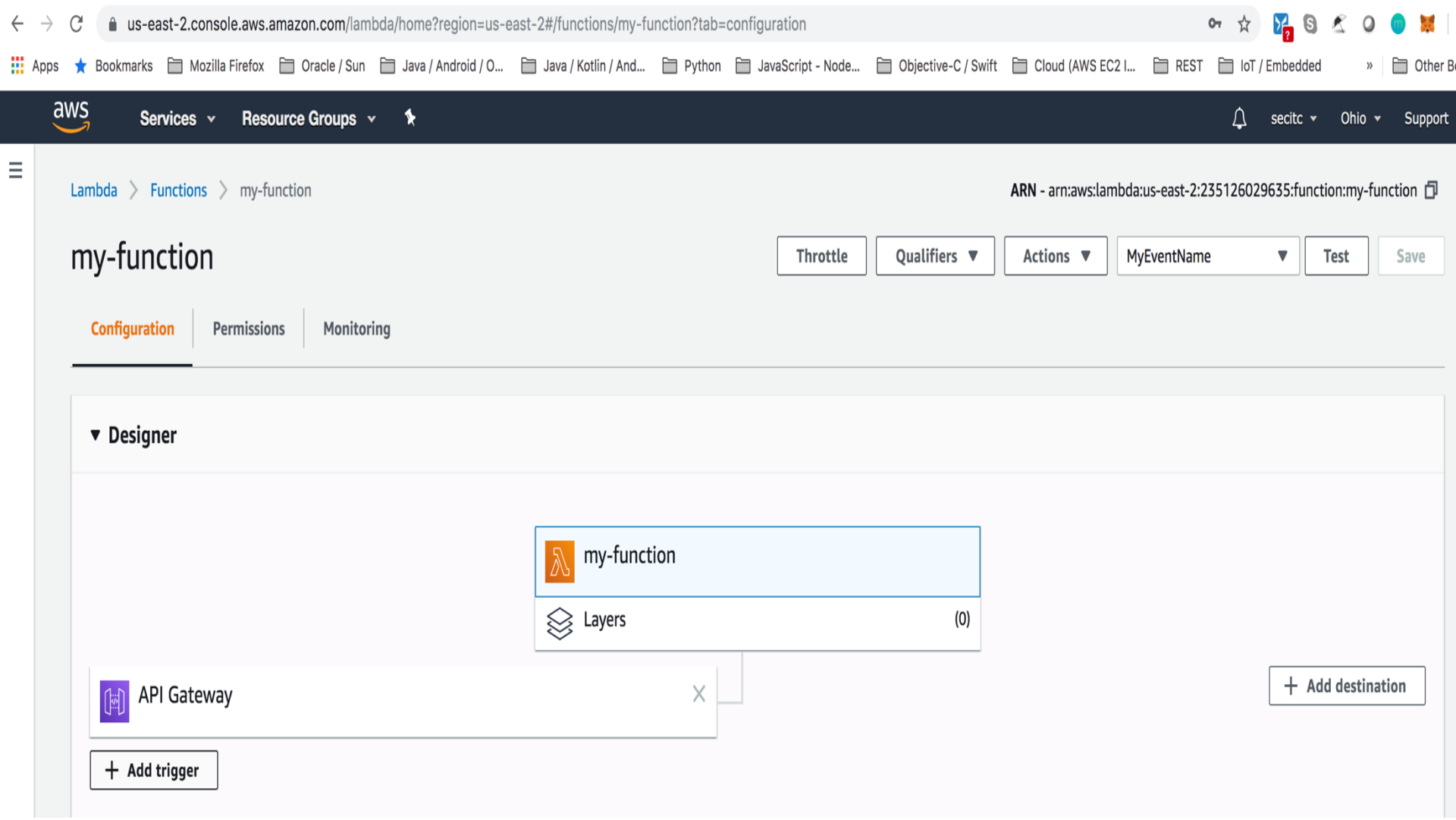
To create a Lambda function

1. Open the AWS Lambda console.
2. Choose **Create a function**.
3. For **Function name**, enter `my-function`.
4. Choose **Create function**.

Lambda creates a Node.js function and an execution role that grants the function permission to upload logs. Lambda assumes the execution role when you invoke your function, and uses it to create credentials for the AWS SDK and to read data from event sources.

https://docs.aws.amazon.com/lambda/latest/dg/nodejs-handler.html | https://docs.aws.amazon.com/lambda/latest/dg/getting-started-create-function.html

2. AWS Lambda – FaaS Cloud



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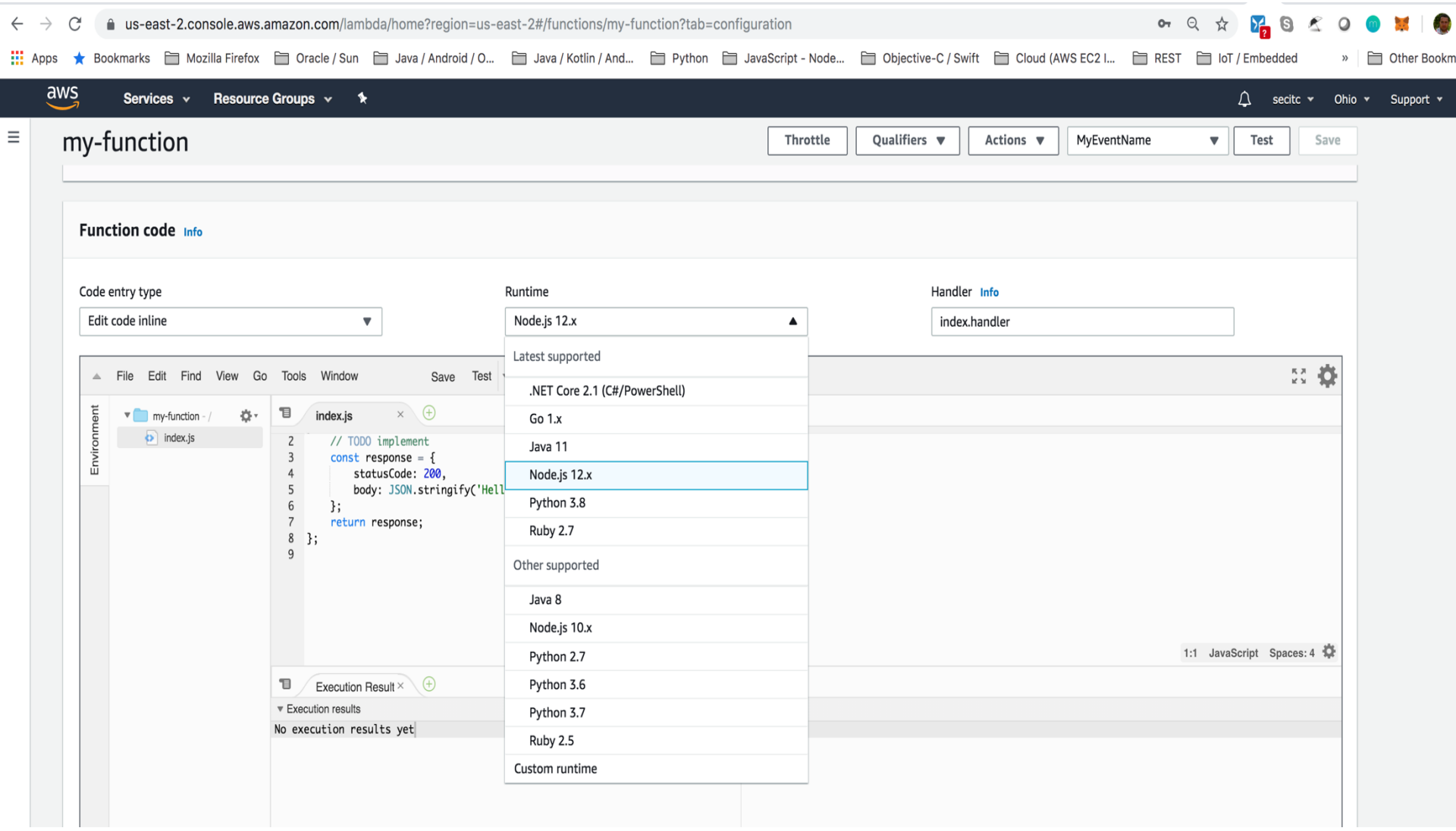
2. AWS Lambda – FaaS Cloud

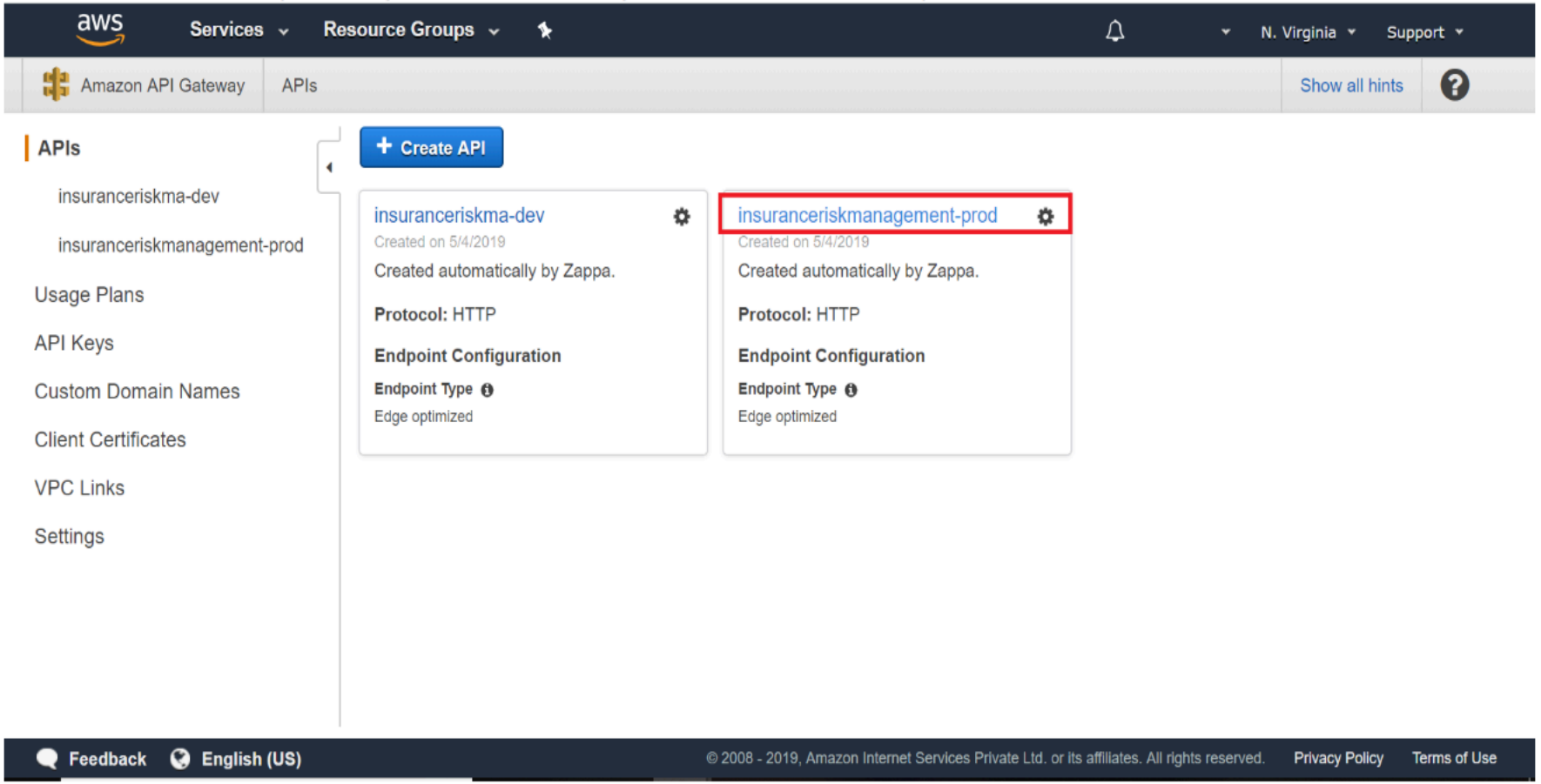


https://docs.aws.amazon.com/lambda/latest/dg/nodejs-handler.html | https://docs.aws.amazon.com/lambda/latest/dg/getting-started-create-function.html

2. AWS Lambda – FaaS Cloud

1. go to https://console.aws.amazon.com/apigateway

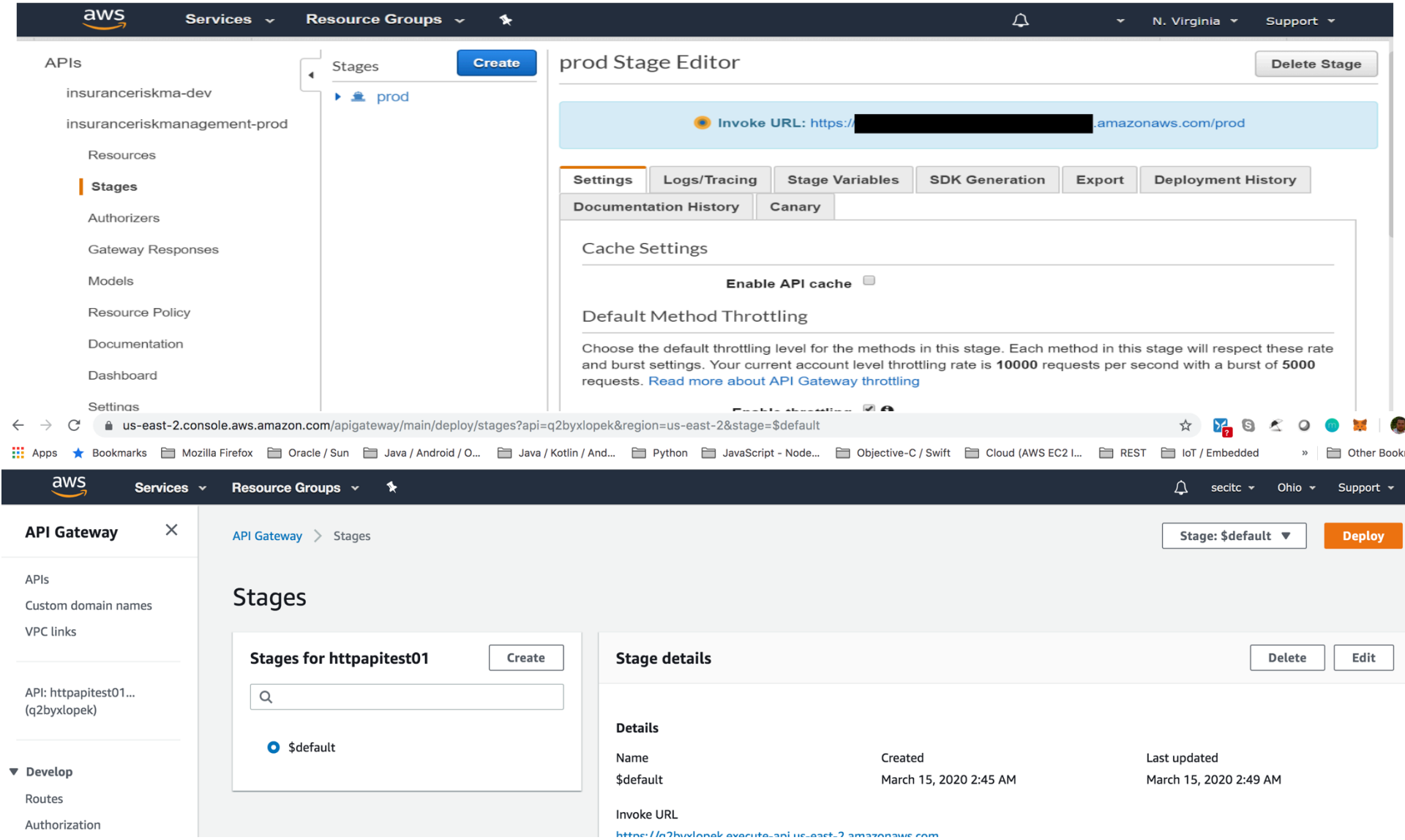
2. select **api link** (which you have deployed on aws lambda).



https://docs.aws.amazon.com/lambda/latest/dg/nodejs-handler.html | https://docs.aws.amazon.com/lambda/latest/dg/getting-started-create-function.html

2. AWS Lambda – FaaS Cloud

3. select **stages** in left side panel and see the **invoke url**.



https://docs.aws.amazon.com/lambda/latest/dg/nodejs-handler.html | https://docs.aws.amazon.com/lambda/latest/dg/getting-started-create-function.html

2. AWS Lambda – FaaS Cloud

Adding a http listener can be done by going to your lambda function, selecting the 'triggers' tab and 'add trigger', finally selecting API Gateway - but as others mentioned this does create a public facing url.

https://docs.aws.amazon.com/lambda/latest/dg/nodejs-handler.html | https://docs.aws.amazon.com/lambda/latest/dg/getting-started-create-function.html

Section Conclusions

JMS – Java Message Service is JEE implementation for MOM – Message Oriented Middleware

The chosen Java Web & Application Server with JMS implementation for testing is Apache TomEE

Apache Kafka demo

JMS DEMO
for easy sharing

Distributed Application Development

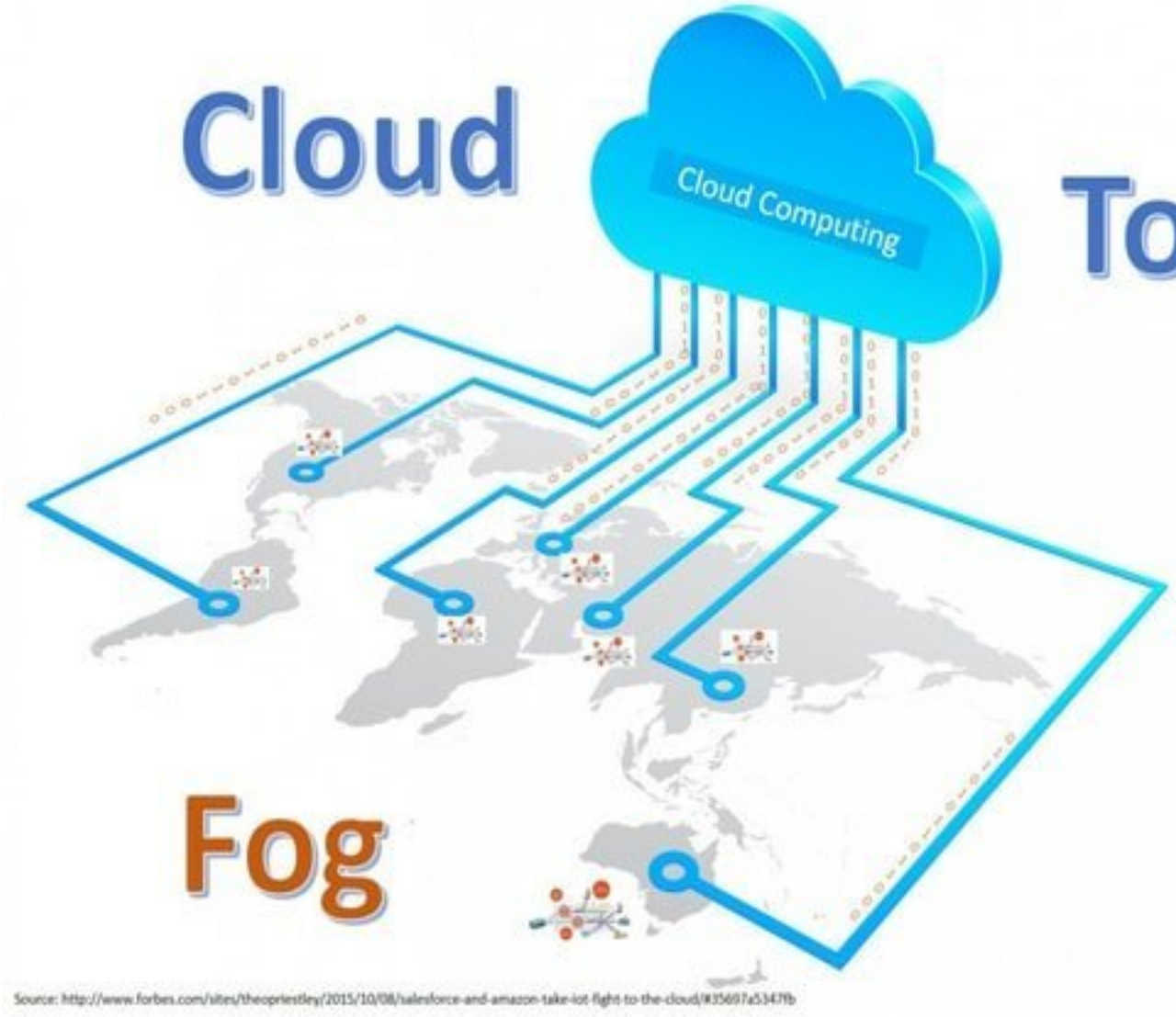
Communicate & Exchange Ideas

Questions & Answers!

But wait…

There's More!

Fog Computing vs. FaaS



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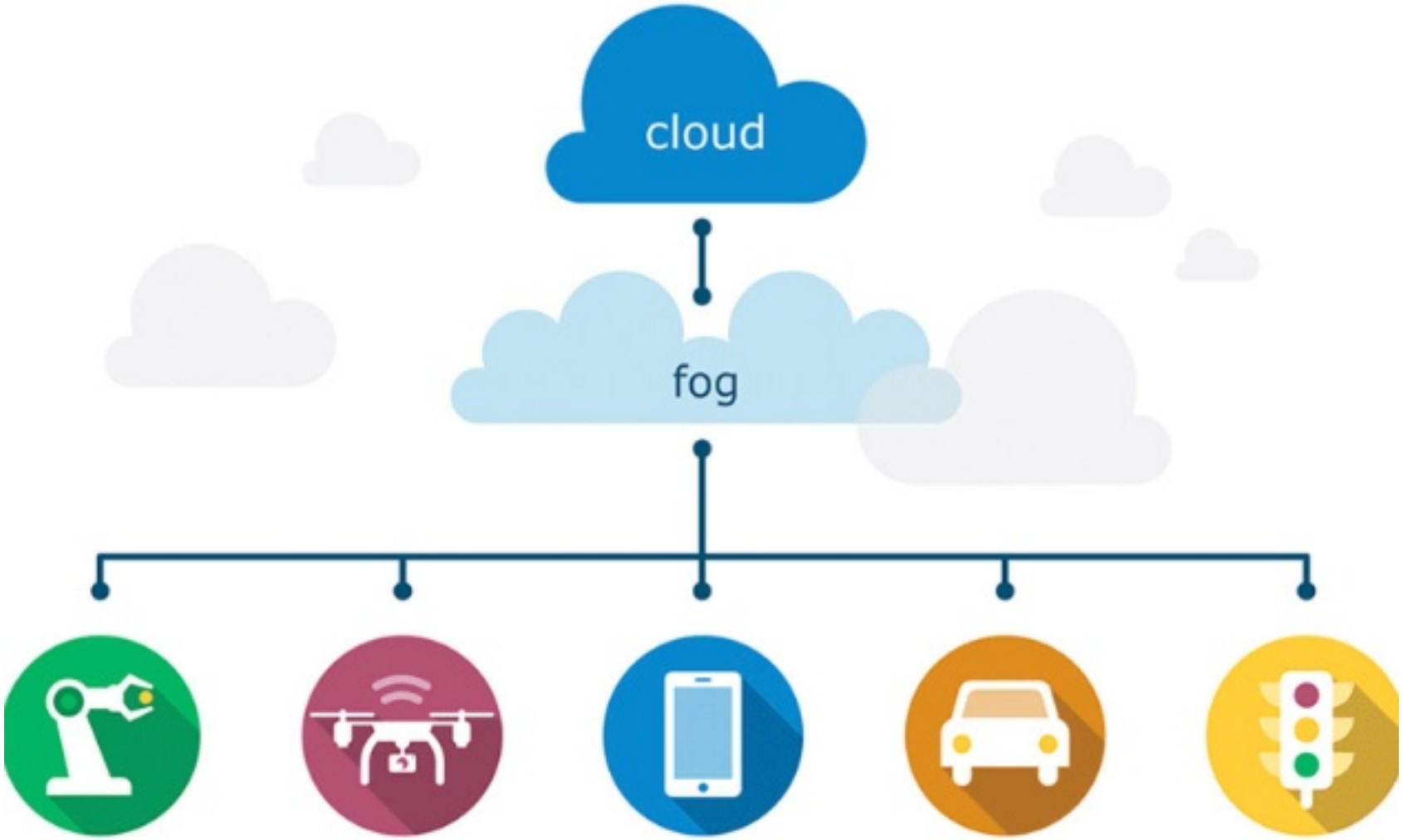
Fog Computing



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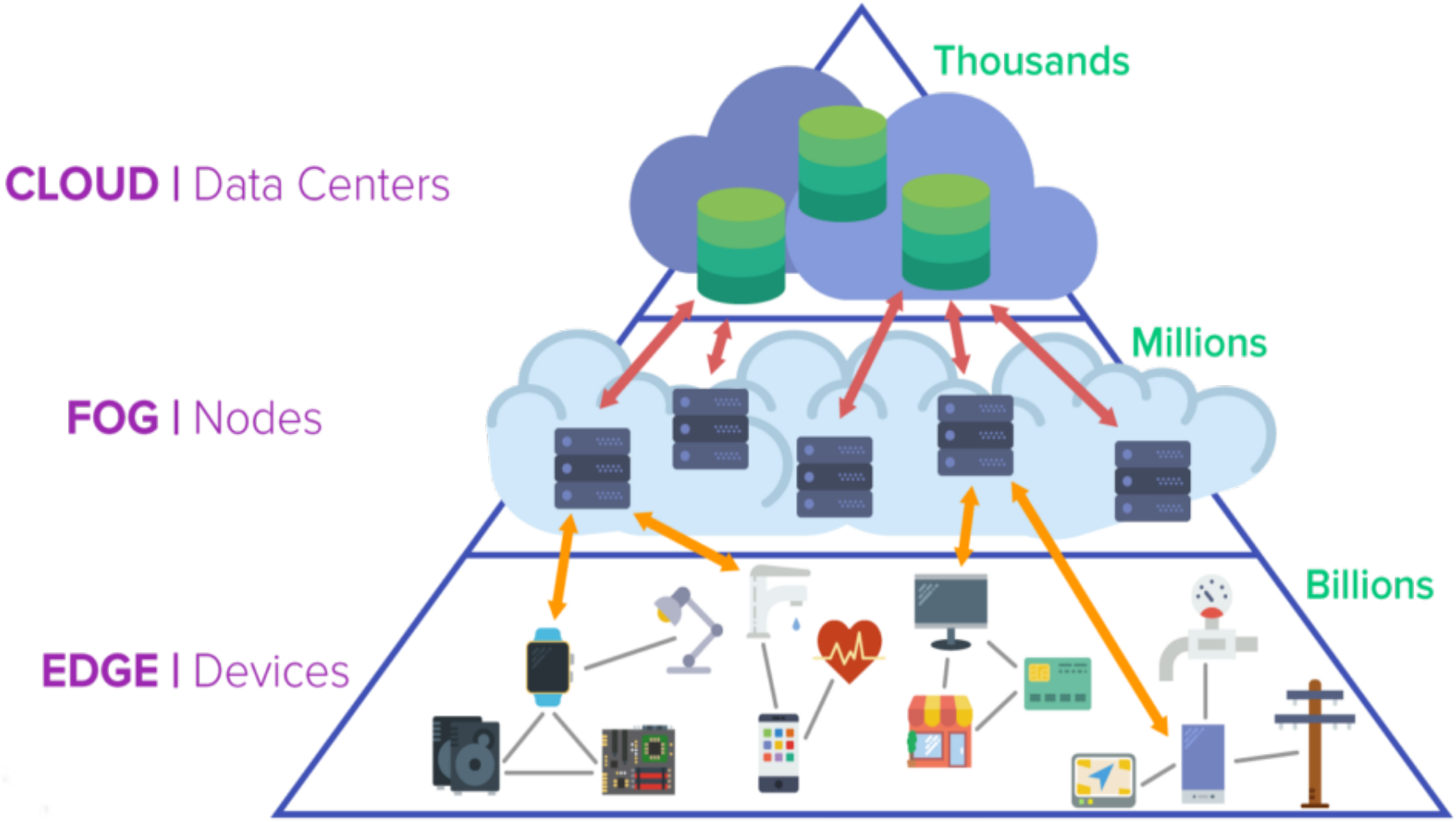
Fog Computing



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Thanks!

DAD – Distributed Application Development
End of Lecture 09