



# **Function as service**

## **Kari Systä, 02.11.2021**

# Function as a service/ serverless computing

**Do you really want to keep  
your containers running all the time  
if you need to pay for it?**

**Do you really want to operate  
and maintain your containers –  
your developers could also  
do something else.**

# Serverless computing

Baldini et al: Serverless Computing:

Current Trends and Open Problems, Research Advances in Cloud Computing, Springer, 2017.

A cloud-native platform

for

- short-running, stateless computation
- event driven applications

which

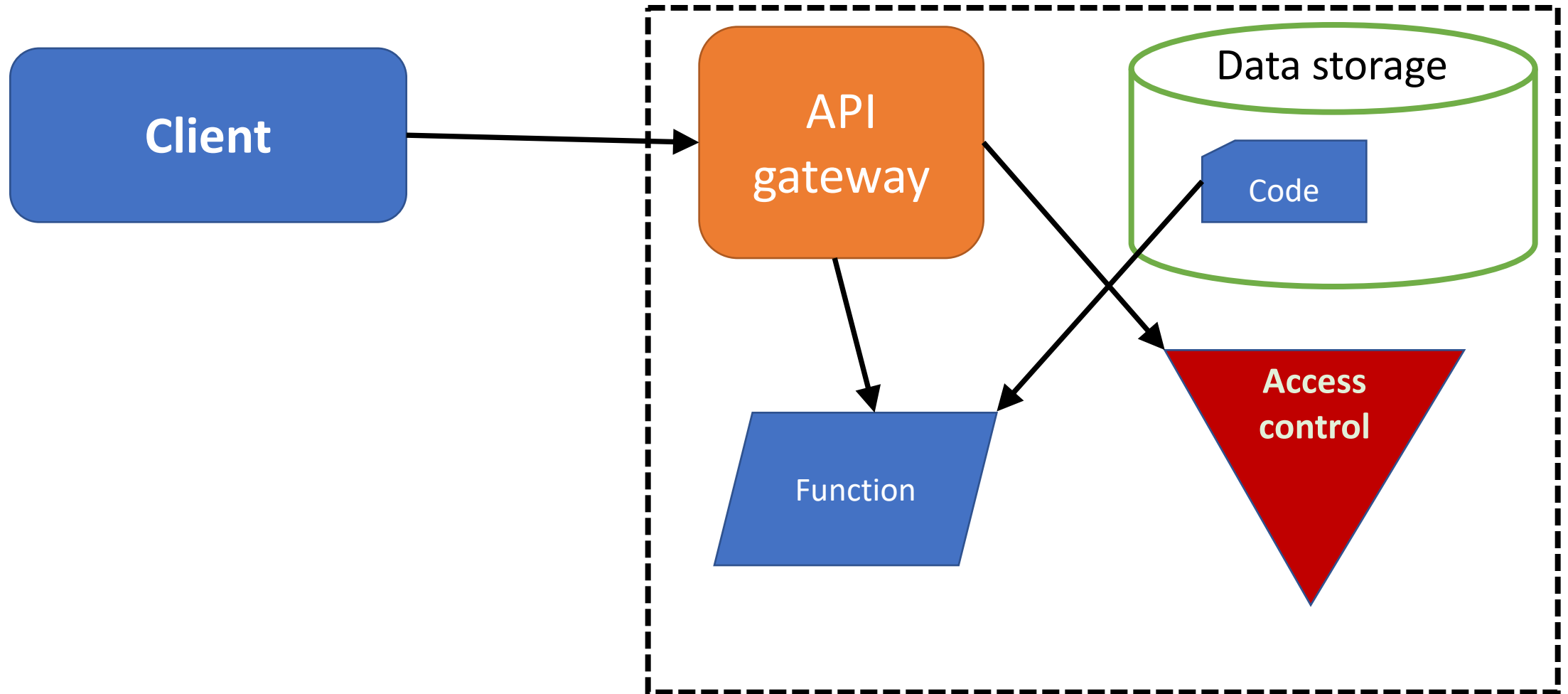
- scale up and down instantly and automatically
- and
- charge for actual usage and high granularity

<https://medium.com/@Boweihan/an-introduction-to-serverless-and-faaS-functions-as-a-service-fb5cec0417b2>

“... you can simply upload modular chunks of functionality into the cloud that are executed independently.

Imagine the possibilities! Instead of scaling a monolithic REST server to handle potential load, you can now split the server into a bunch of functions which can be scaled automatically and independently.”

# Function as a service?



# A simple example from

<https://www.scalyr.com/blog/simple-detailed-introduction-google-cloud-functions/>

- Package.json

```
{ "name": "my-first-function", "version": "0.0.1" }
```

- Code

```
exports.helloWorld = (req, res) => {  
  let message = req.query.message ||  
    req.body.message || 'Hello World!';  
  res.status(200).send(message);  
};
```

- Deploy with

```
gcloud functions deploy my-first-function --trigger-http \  
--runtime nodejs8 --entry-point=helloWorld
```

- Use as

```
http://<location>/my-first-function?message=BAM
```

## A simple example from

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- Deploy with

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gcloud functions deploy my-first-function --trigger-http \<\  
--runtime nodejs --entry-point=helloWorld
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- Use as

```
http://<location>/my-first-function?message=BAM
```

**Something  
to do with  
functional programming?**



# The actions with AWS Lambda

<https://aws.amazon.com/getting-started/tutorials/build-serverless-app-codestar-cloud9>

## History

CodeStar

CodeBuild

Console Home

Billing

Amazon Comprehend

EC2

codestar|

Group

A-Z

CodeStar

Quickly develop, build, and deploy applications

EC2

Lightsail ↗

Elastic Container Service

Lambda

Batch

Elastic Beanstalk

**Storage**

S3

EFS

Glacier

Storage Gateway

**Database**

Relational Database Service

DynamoDB

ElastiCache

Amazon Redshift

**Migration**

AWS Migration Hub

CodeStar

CodeCommit

CodeBuild

CodeDeploy

CodePipeline

Cloud9

X-Ray

**Management Tools**

CloudWatch

AWS Auto Scaling

CloudFormation

CloudTrail

Config

OpsWorks

Service Catalog

Systems Manager

Trusted Advisor

Managed Services

**Media Services**

Elastic Transcoder

Amazon SageMaker

Amazon Comprehend

AWS DeepLens

Amazon Lex

Machine Learning

Amazon Polly

Rekognition

Amazon Transcribe

Amazon Translate

**Analytics**

Athena

EMR

CloudSearch

Elasticsearch Service

Kinesis

QuickSight ↗

Data Pipeline

AWS Glue

**Security, Identity & Compliance**

Amazon Sumerian ↗

**Application Integration**

Step Functions

Amazon MQ

Simple Notification Service

Simple Queue Service

SWF

**Customer Engagement**

Amazon Connect

Pinpoint

Simple Email Service

**Business Productivity**

Alexa for Business

Amazon Chime ↗

WorkDocs

WorkMail

^ close



Services ▾

Resource Groups ▾



Oregon ▾

Support ▾



## AWS CodeStar

AWS CodeStar lets you quickly develop, build and deploy applications on AWS.

[Start a project](#)

## Create service role

AWS CodeStar would like permissions to administer AWS resources and IAM permissions on your behalf. IAM users with CodeStar Full Access will be able to create and manage CodeStar project resources and grant other IAM users in this account access to those resources. Is this ok?

**Yes, create role**

No, go back

You must be logged in as an IAM administrative user in order to create the service role.

To learn more and view the service role policy, see the [AWS CodeStar User Guide](#).

Filter

### Application category

- Web application
- Web service
- Static Website
- AWS Config Rule

### Programming languages

- C#
- Go
- HTML 5
- Java
- Node.js
- PHP
- Python
- Ruby

AWS services

## Choose a project

Start a new software project



### Ruby on Rails



Web application



AWS Elastic Beanstalk  
(runs in a managed application environment)



### Java Spring



Web application



AWS Elastic Beanstalk  
(runs in a managed application environment)



### Java Spring



Web application



Amazon EC2  
(runs on virtual servers that you manage)

### Go

Web application

AWS Lambda  
(running serverless)



### Node.js



Web application



AWS Lambda  
(running serverless)



## Application category

- Web application
- Web service
- Static Website
- AWS Config Rule

## Programming languages

- C#
- Go
- HTML 5
- Java
- Node.js
- PHP
- Python
- Ruby

## AWS services

## Choose a project template

Start a new software project on AWS in minutes using a project template. [Help me choose](#)



### Ruby on Rails



Web application



AWS Elastic Beanstalk  
(runs in a managed application environment)



### Ruby on Rails



Web application



Amazon EC2  
(runs on virtual servers that you manage)



### Go



Web application



AWS Lambda  
(running serverless)



### Java Spring



Web application



AWS Elastic Beanstalk  
(runs in a managed application environment)



### Java Spring



Web application



Amazon EC2  
(runs on virtual servers that you manage)



### Node.js



Web application



AWS Lambda  
(running serverless)



Select template



Set up tools



Start coding

## Project details

### Project name

### Project ID ⓘ

[Edit](#)

### Which repository do you want to use?

AWS CodeStar will store the project's source code with the service you choose here.



#### AWS CodeCommit

Highly available Git source control from AWS. Includes encryption, IAM integration, and more.



#### GitHub

Creates a GitHub source repository for this project. Requires an existing GitHub account.

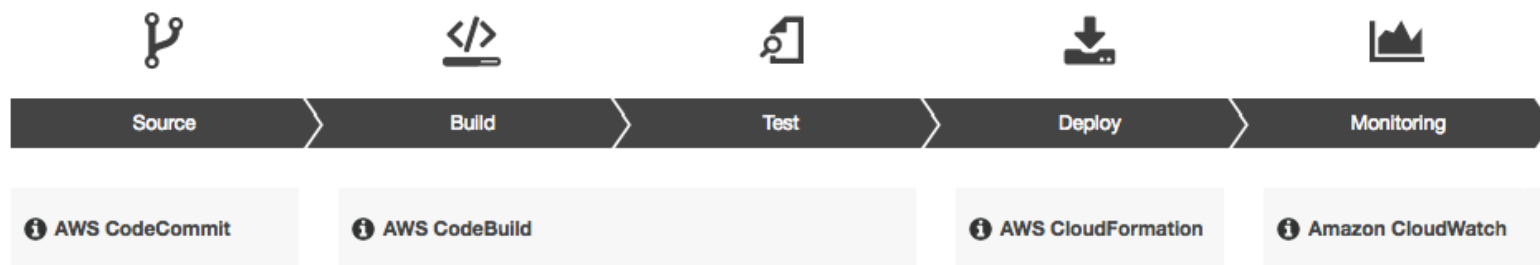
### Repository name

[Previous](#)[Next](#)



## Review project details

AWS CodeStar includes all of the tools and services you need for a development project.  
This project includes an **AWS CodePipeline** connected with the following tools:



AWS CodeStar would like permission to administer AWS resources on your behalf. [Learn more](#)

[Previous](#)[Create Project](#)



## Pick how you want to edit your code



### AWS Cloud9

Edit your AWS CodeStar project code with a cloud-based IDE that includes a command line interface. [More info](#)



### Command line tools

Edit AWS CodeStar project code by connecting directly to your project's Git source repository.



### Eclipse

Configure the AWS Toolkit for Eclipse to edit your AWS CodeStar project code in Eclipse.



### Visual Studio

Configure the AWS Toolkit for Visual Studio to edit your CodeStar project code in Microsoft Visual Studio 2015 and later.

You can switch tools at **any time**.

Skip

Next






## Set up your AWS Cloud9 environment



Pick an instance type for this environment (not your overall project)

Recommended instances Other types



**t2.micro**  
1 GIB RAM + 1 vCPU. Ideal for educational use and exploration. **FREE TIER ELIGIBLE**



**t2.small**  
2 GIB RAM + 1 vCPU. Recommended for small-sized web projects.



**m3.medium**  
3.75 GIB RAM + 1 vCPU. Recommended for production and general-purpose development.

- ▶ Network settings (advanced)
- ▶ Environment name and description
- ▶ Cost-saving settings

Previous

Next



Dashboard



IDE



Code



Build



Deploy



Pipeline



Team



Extensions



Project



Success! Your project and IDE are set up and ready to use.

Dismiss

Start coding

Add tile



## Welcome to nodejs-serverless-project!

Close

Let us help you get started.

[Learn about AWS CodeStar](#)[Set up your team](#)[Configure issue tracking](#)



Dashboard



IDE



Code



Build



Deploy



Pipeline



Team



Extensions



Project



Success! Your project and IDE are set up and ready to use.

[Dismiss](#)[View your app](#)[Start coding](#)

Add tile



## Welcome to nodejs-serverless-project!

[Close](#)

Let us help you get started.

[Learn about AWS CodeStar](#)[Set up your team](#)[Configure issue tracking](#)

### Team wiki tile

Edit this tile to save your own project links, code samples and notes to share with your team. You can use [markdown](#) to **format your text**.

Some other things to try in your project...

- [Access your application](#)
- Read "What do I do next?" in README.md in project source repository
- [Add team members](#)
- Set up issue tracking (under "Extensions")
- [Customize project dashboard](#)
- [View AWS CodeStar documentation](#)
- [Visit the AWS CodeStar forum](#)



### AWS Cloud9 environments

[See my environments](#)

### Application endpoints

<https://vnhwxc5i6.execute-api.us-west-2.amazona...>

Environment

- nodejs-serverle
  - nodejs-serverle
  - README.md

Navigate

Commands

Welcome

Developer Tools

# AWS Cloud9

## Welcome to your development environment

AWS Cloud9 allows you to write, run, and debug your code with just a browser. You can [tour the IDE](#), [write code for AWS Lambda and Amazon API Gateway](#), [share your IDE](#) with others in real time, and much more.

### Getting started

- Create File
- Open File...
- Upload Files...
- Clone Git Repository

### AWS Cloud9 for AWS Lambda

AWS Lambda is a compute service that lets you run code without provisioning or managing servers. AWS Lambda executes your code only when needed and scales automatically, from a few requests per day to thousands per second.

- Create Lambda Function...
- Import Lambda Function...

### Configure AWS Cloud9

```

bash - "ip-172-31" x Immediate x bash - "ip-172-31" x
/tmp/git-cloning-runner-1521500412137-004279210498.sh
ec2-user:~/environment $ /tmp/git-cloning-runner-1521500412137-004279210498.sh
Cloning into '/home/ec2-user/environment/nodejs-serverle'...
remote: Counting objects: 19, done.
Unpacking objects: 100% (19/19), done.

Navigate to your cloned repository by typing "cd /home/ec2-user/environment/nodejs-serverle" to start working with "https://git-codecommit.us-east-1.amazonaws.com/v
dejs-serverless-project"

To set your display name run "git config --global user.name YOUR_USER_NAME"
To set your display email run "git config --global user.email YOUR_EMAIL_ADDRESS"

ec2-user:~/environment $ cd /home/ec2-user/environment/nodejs-serverle
ec2-user:~/environment/nodejs-serverle (master) $
  
```



Environment

⌘ E | ⌘ P

**README.md**  
/README.md

**buildspec.yml**  
/nodejs-serverle/buildspec.yml

**index.js**  
/nodejs-serverle/index.js

**README.md**  
/nodejs-serverle/README.md

**template.yml**  
/nodejs-serverle/template.yml

**Index.html**  
/nodejs-serverle/public/index.html

**gradients.css**  
/nodejs-serverle/public/assets/css/g

**styles.css**  
/nodejs-serverle/public/assets/css/s

**tweet.svg**  
/nodejs-serverle/public/assets/img/t

**set-background.js**  
/nodejs-serverle/public/assets/js/set

Navigate

Commands

Welcome x +

Developer Tools

# AWS Cloud9

## Welcome to your development environment

AWS Cloud9 allows you to write, run, and debug your code with just a browser. You can [tour the IDE](#), write code for [AWS Lambda](#) and [Amazon API Gateway](#), share your [IDE](#) with others in real time, and much more.

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#### Getting started

[Create File](#)

[Open File...](#)

[Upload Files...](#)

[Clone Git Repository](#)

bash - "ip-172-31" x Immediate x bash - "ip-172-31" x +

```
ec2-user:~/environment/nodejs-serverle (master) $
```

Collaborate

Outline

AWS Resources

Debugger

Environment

- nodejs-serverle
  - nodejs-serverle
  - README.md

Commands

```
Welcome x index.html x +
50     <li><a class="home-link" href="https://aws.amazon.com/">Home</a></li>
51     <li><a href="https://aws.amazon.com/what-is-cloud-computing/">About</a></li>
52     <li><a href="https://aws.amazon.com/solutions/">Services</a></li>
53     <li><a href="https://aws.amazon.com/contact-us/">Contact</a></li>
54     </ul>
55     </nav>
56 </header>
57
58 <div class="message">
59     <a class="twitter-link" href="http://twitter.com/home/?status=I%20created%20a%20project%20with%20AWS%20Code
60     <div class="text">
61         <h1>Congratulations!</h1>
62         <h2>You just created a Node.js web application</h2>
63     </div>
64 </div>
65 </div>
66
67 <footer>
68     <p class="footer-contents">Designed and developed with <a href="https://aws.amazon.com/careers/devtools-jobs/">
69 </p>
70 </footer>
71 <script src="assets/js/set-background.js"></script>
72 </body>
73
74 </html>
75
```

(4 Bytes) 62:56 HTML Spaces: 4

. \* ? a A " " [ ] \_ appl 1 of 1 < > A A Replace With Replace Replace All

bash - "ip-172-31" x Immediate x bash - "ip-172-31" x +

```
ec2-user:~/environment/nodejs-serverle (master) $
```

Collaborate

Outline

AWS Resources

Debugger

AWS Cloud9 File Edit Find View Goto Run Tools Window Support Preview Run Share

Environment  
nodejs-serverle  
nodejs-serverle  
README.md

Collaborate  
Outline  
AWS Resources  
Debugger

Commands  
Navigate

```
48     <nav class="website-nav">
49         <ul>
50             <li><a class="home-link" href="https://aws.amazon.com/">Home</a></li>
51             <li><a href="https://aws.amazon.com/what-is-cloud-computing/">About</a></li>
52             <li><a href="https://aws.amazon.com/solutions/">Services</a></li>
53             <li><a href="https://aws.amazon.com/contact-us/">Contact</a></li>
54         </ul>
55     </nav>
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74 </html>
```

62:66 HTML Spaces: 4

.\*? aA " " [ ] 1 appl 1 of 1 < > A:A Replace With Replace Replace All

bash - "ip-172-31" x Immediate x bash - "ip-172-31" x

ec2-user:~/environment/nodejs-serverle (master) \$

Environment

- myproject
  - nodejs-serverle
    - README.md

Commands

Navigate

```

52     <li><a href="https://aws.amazon.com/solutions/">Services</a></li>
53     <li><a href="https://aws.amazon.com/contact-us/">Contact</a></li>
54   </ul>
55 </nav>
56 </header>
57
58   <div class="message">
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60     <div class="text">
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73
74 </html>
75

```

.\*? aA " " [ ] 1 app 0 of 0 < > A A

bash - "ip-172-31-5" x Immediate x git - "ip-172-31-5" x

```

no changes added to commit (use "git add" and/or "git commit -a")
ec2-user:~/environment/nodejs-serverle (master) $ git add public/index.html
ec2-user:~/environment/nodejs-serverle (master) $ git commit -m "add three bangs"
[master f999f6b] add three bangs
1 file changed, 1 insertion(+), 1 deletion(-)
ec2-user:~/environment/nodejs-serverle (master) $ git push origin master
Counting objects: 4, done.
Compressing objects: 100% (4/4), done.
Writing objects: 100% (4/4), 378 bytes | 378.00 KiB/s, done.
Total 4 (delta 2), reused 0 (delta 0)
To https://git-codecommit.us-east-1.amazonaws.com/v1/repos/myproject
f5ae238..f999f6b master -> master
ec2-user:~/environment/nodejs-serverle (master) $

```



- Dashboard
- IDE
- Code
- Build
- Deploy
- Pipeline
- Team
- Extensions
- Project

## Commit history: nodejs-serverless-project

master

**R** add three bangs  
committed 13 minutes ago

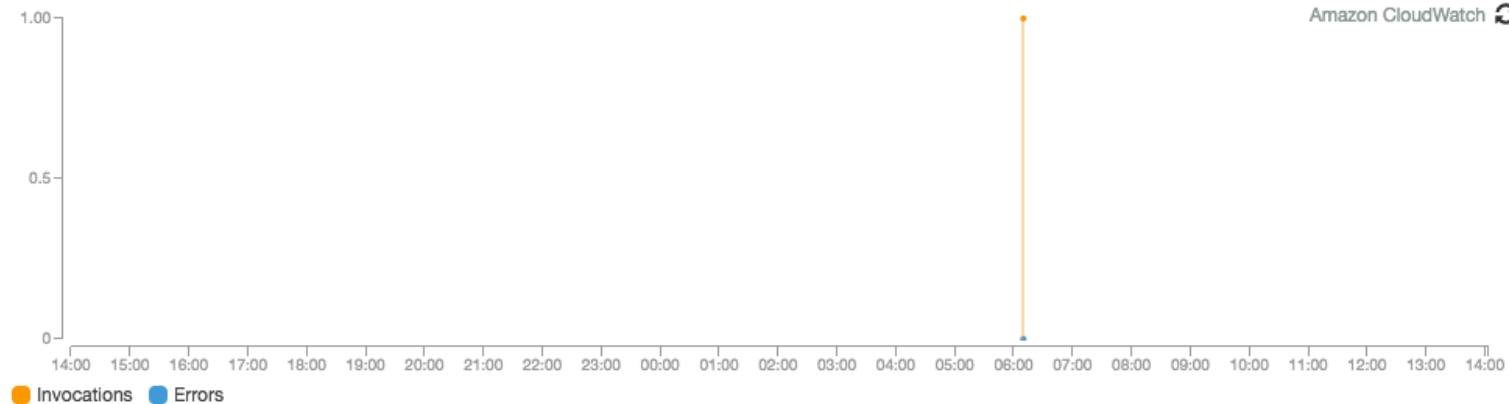
760b30a

**AC** Initial commit made by AWS CodeStar during project creation.  
AWS CodeStar committed 18 hours ago

8c80bf2

[Connect](#)[AWS CodeCommit details](#)

## Application activity



Amazon CloudWatch

[Amazon CloudWatch details](#)

## JIRA

Track work items and issues for your AWS CodeStar projects with Atlassian JIRA integration.

## Continuous deployment

AWS CodePipeline

[Release change](#)

## Source

ApplicationSource CodeCommit  
Succeeded[Commit history](#)

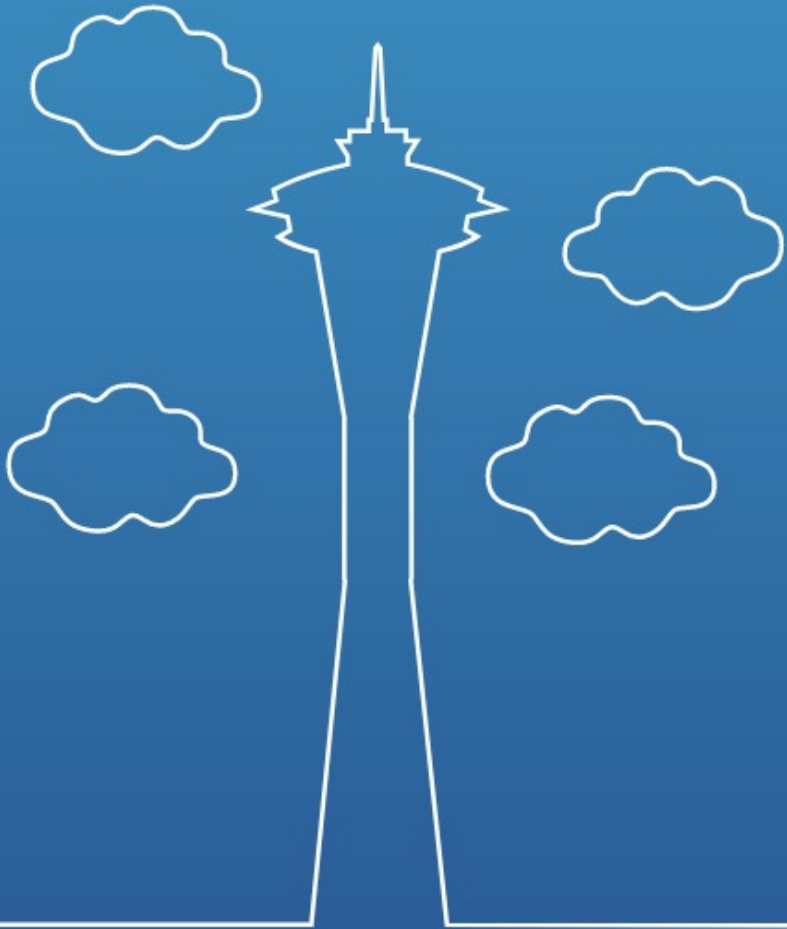
## Build

PackageExport CodeBuild  
Succeeded

## Deploy

ExecuteChangeSet CloudFormation  
In progress[Deploy history](#)[Pipeline history](#)[AWS CodePipeline details](#)

[Home](#) [About](#) [Services](#) [Contact](#)



# Congratulations!

You just created a Node.js web application!!!



Designed and developed with ♥ in Seattle.

[AWS CodeStar](#)

+ Create a new project

nodejs-s

Rename

Delete

Created 18 hours ago

Dashboard

Code

Team

# Claimed FaaS advantages

- Smaller for developer since infrastructure is handled by somebody else  
=> more time for writing application code
- Inherently scalable
- No need to pay for idle resources  
(temptation to miss-use)
- Available and fault tolerant
- No explicit multi-tenancy
- Forces modular business logic

# Claimed FaaS disadvantages

- Decreased transparency
- Maybe challenging to debug
- Autoscaling of functions may lead to autoscaling of cost
- Keeping track of huge numbers of functions is tough
- Chaching of requests?