Chapter 1: Introduction to Microservices

monolith server

- User registration
- Product catalog
- Shopping cart
- Payment integration
- E-mail notifications
- Statistics collecting
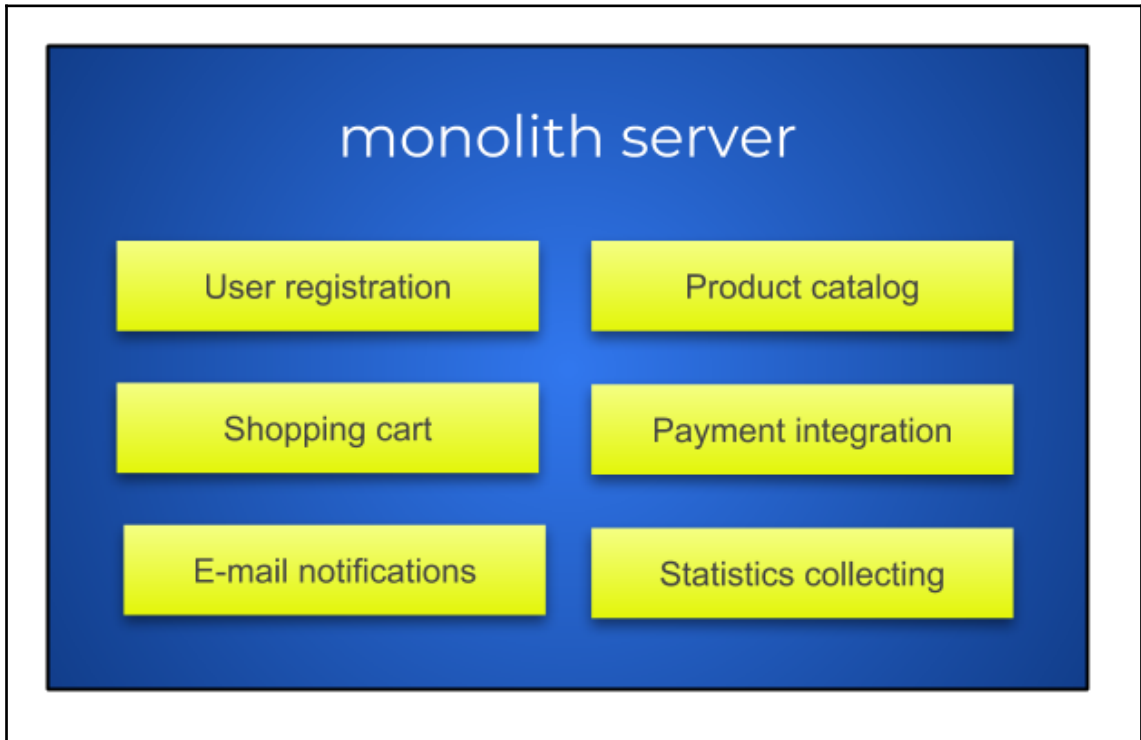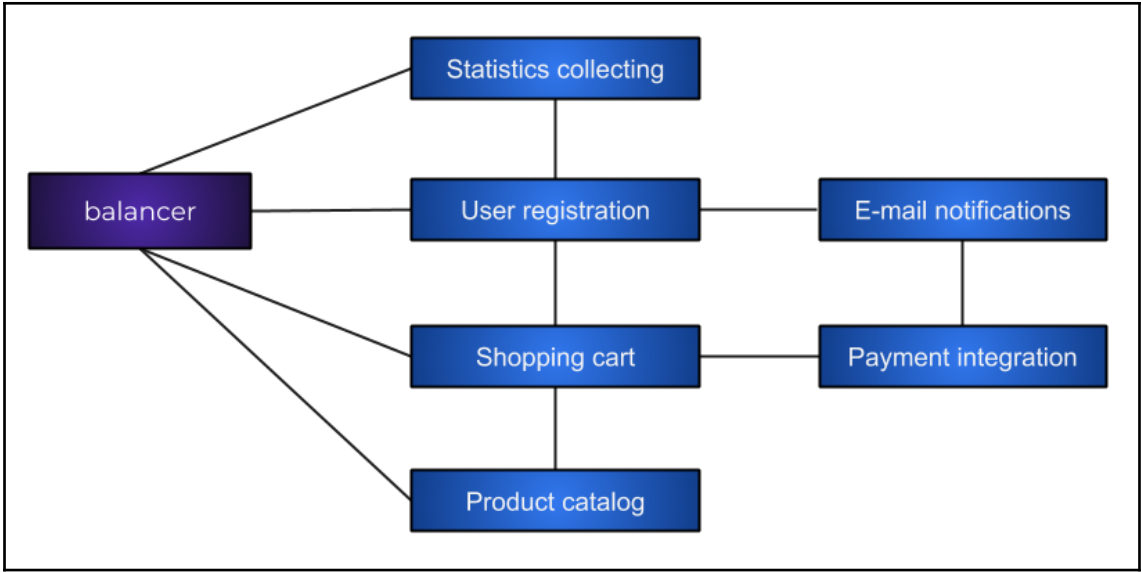
Chapter 2: Developing a Microservice with the Hyper Crate

localhost:8080/   ×   +

← → C   ⓘ localhost:8080   ··· ☑ ☆   »   ≡

```
Rust Microservice
```

Rust Microservice - Mozilla Firefox   ×

File   Edit   View   History   Bookmarks   Tools   Help

Rust Microservice   ×   +

← → C ⌂   ⓘ localhost:8080   ··· ☑ ☆   ↓ » ≡

Rust Microservice

☐   ▣ Console   ▭ Debugger   ▢ Inspector   {} Style Editor   ⓒ Performance   ☰ Network   »   ▤ ··· ×

🗑   ▽ Filter URLs   ∥ ☐ Persist Logs ☐ Disable cache   No throttlin ⇕ HAR ⇕

All	HTML	CSS	JS	XHR	Fonts	Images	Media	WS	Other

Stat...	Method	Fil...	Do	Cause	Type	Transferred	Size	0 ms	160
200	GET	/	🌐 lo...	document	html	231 B	154 B	→ 0 ms	

ⓒ   One request | 154 B / 231 B transferred | Finish: 0 ms | DOMContentLoaded: 136 ms | load: 184 ms

Mozilla Firefox ×

localhost:8080/funny_cats × +

← → C ⌂ ⓘ localhost:8080/funny_cats ⋯ ☑ ☆ ↓ » ≡

⬚ ▷ Console ◯ Debugger ⬚ Inspector { } Style Editor ⓒ Performance ≡ Network » ⊟ ⋯ ×

🗑 ▽ Filter URLs | | ☐ Persist Logs ☐ Disable cache No throttlin ÷ HAR ÷

All HTML CSS JS XHR Fonts Images Media WS Other

Stat...	Method	Fil	Do	Cause	Type	Transferred	Size	0 ms	160
404	GET	funny...	⊕ lo...	document	plain	82 B	0 B	→ 0 ms	

ⓒ One request | 0 B / 82 B transferred | Finish: 0 ms | DOMContentLoaded: 115 ms | load: 177 ms
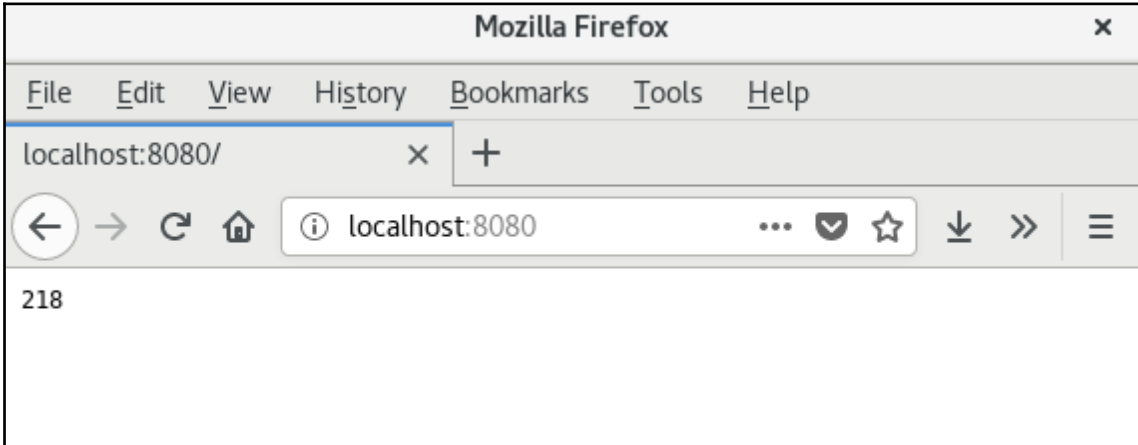
Mozilla Firefox ×

File Edit View History Bookmarks Tools Help

localhost:8080/users/ × +

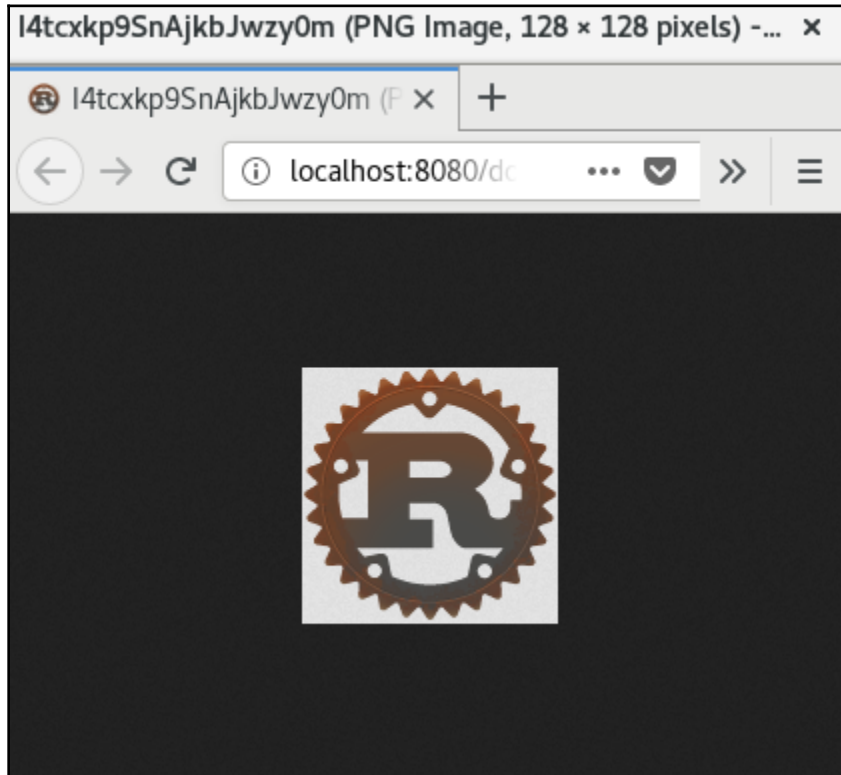← → C ⌂ ⓘ localhost:8080/users/ ⋯ ☑ ☆ ↓ » ≡

0,2

Chapter 3: Logging and Configuring Microservice
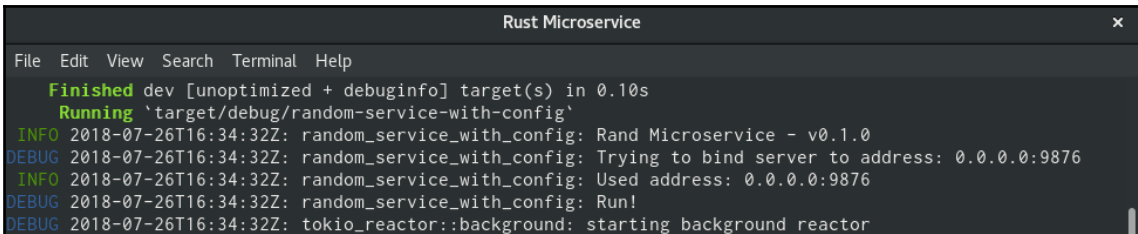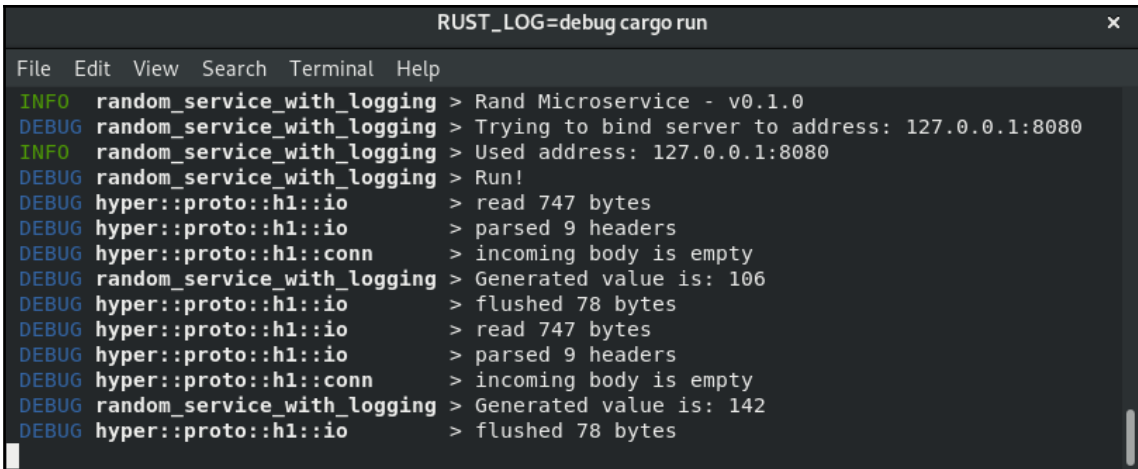
Chapter 4: Data Serialization and Deserialization with the Serde Crate

No images

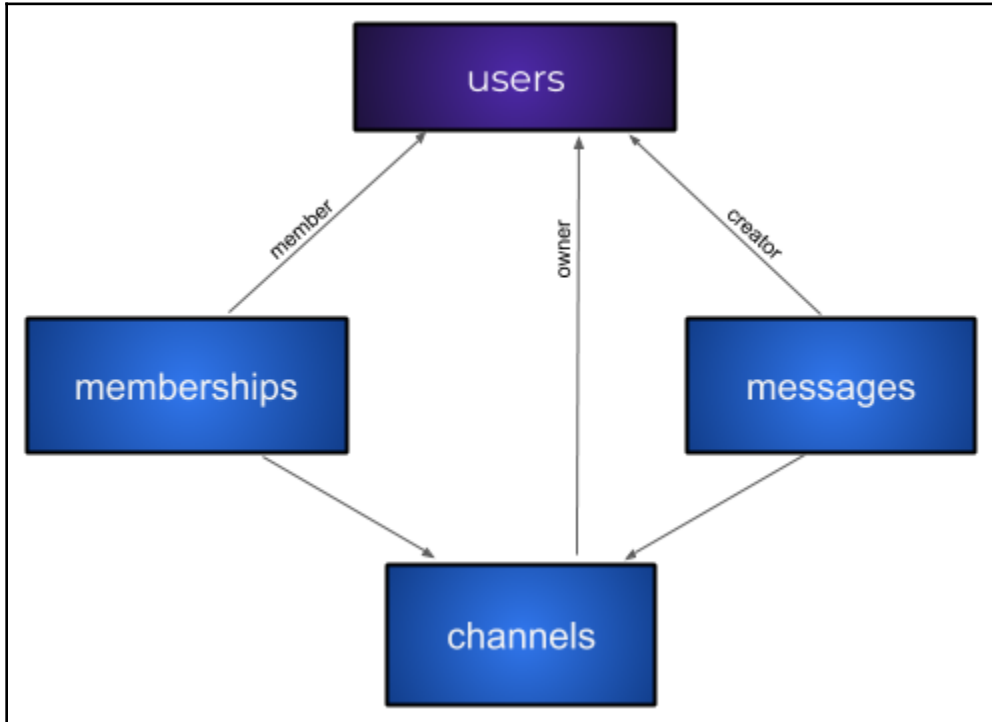# Chapter 5: Understanding Asynchronous Operations with Futures Crate

Chapter 6: Reactive Microservices - Increasing Capacity and Performance
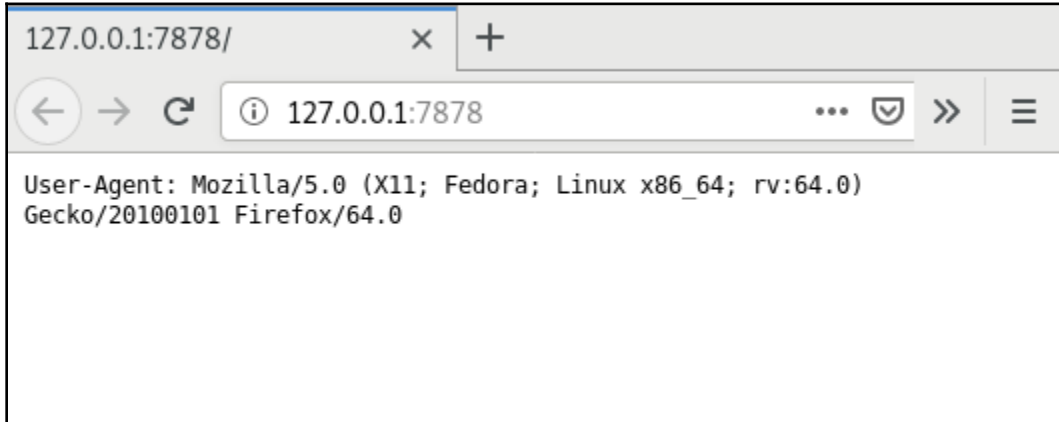
No images

Chapter 7: Reliable Integration with Databases

No images

Chapter 8: Interaction to Database with Object-Relational Mapping

Chapter 9: Simple REST Definition and Request Routing with Frameworks
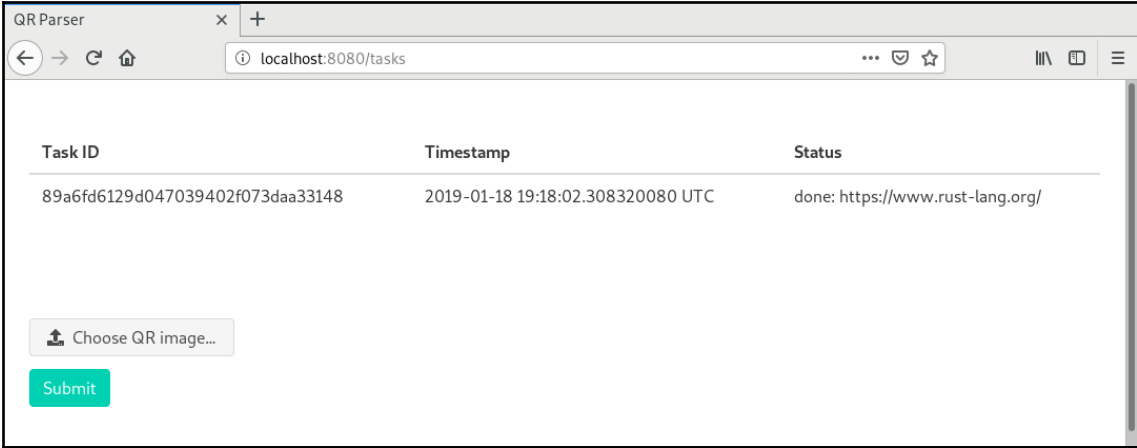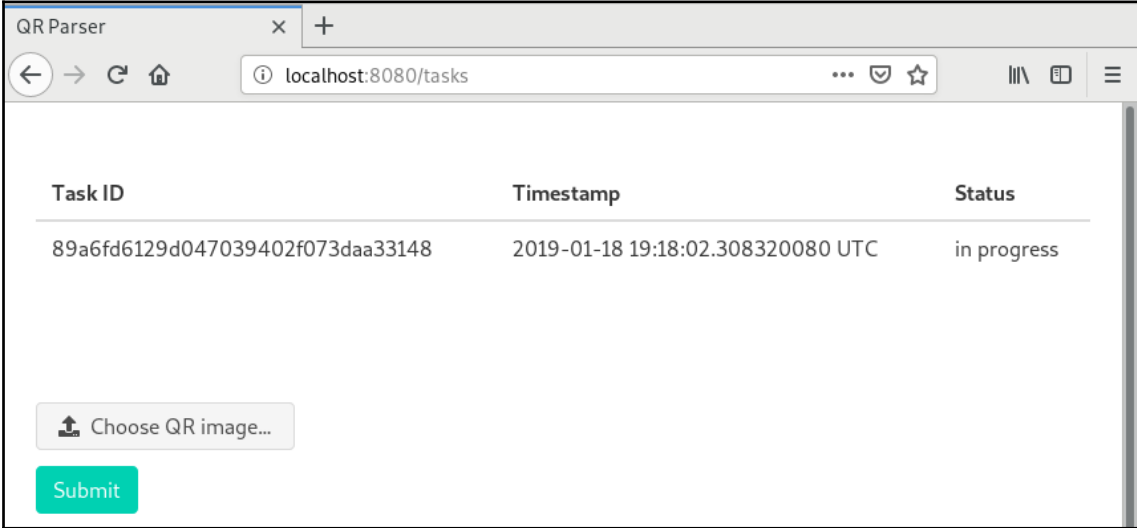
Chapter 10: Background Tasks and Thread Pools in Microservices

No images

Chapter 11: Involving Concurrency with Actors and the Actix Crate

No images

Chapter 12: Scalable Microservices Architecture

Chapter 13: Testing and Debugging Rust Microservices

mitmproxy - Mozilla Firefox   ×

File   Edit   View   History   Bookmarks   Tools   Help

● mitmproxy   ×   +

① 127.0.0.1:7777/#/flows/47033641-6dc1-40d0-9573-8257fe418a69/request

mitmproxy   Start   Options   Flow

Replay   Duplicate   Revert   Delete   Download   Resume   Abort

Flow Modification   Export   Interception

Path	Method	Status	Size	Time
http://localhost:7000/	GET	302	0	34ms
http://localhost:7000/index.html	GET	200	271b	41ms
http://localhost:7000/style.css	GET	404	0	53ms
http://localhost:7000/script.js	GET	200	303b	52ms
http://localhost:7000/api/comments	GET	200	103b	38ms
http://localhost:7000/favicon.ico	GET	404	0	23ms
http://localhost:7000/api/signup	POST	302	45b	917ms
http://localhost:7000/login.html	GET	200	274b	30ms
http://localhost:7000/style.css	GET	404	0	24ms
http://localhost:7000/api/comments	GET	200	103b	33ms
http://localhost:7000/api/signin	POST	302	45b	928ms
http://localhost:7000/comments.html	GET	200	264b	36ms
http://localhost:7000/style.css	GET	404	0	26ms
http://localhost:7000/api/comments	GET	200	103b	37ms
http://localhost:7000/api/new_comment	POST	302	21b	91ms
http://localhost:7000/comments.html	GET	200	264b	33ms

Request   Response   Details

POST http://localhost:7000/api/signin HTTP/1.1

Host	localhost
User-Agent	Mozilla/5.0 (X11; Fedora; Linux x86_64; rv: 64.0) Gecko/20100101 Firefox/64.0
Accept	text/html,application/xhtml+xml,application /xml;q=0.9,*/*;q=0.8
Accept-Language	en-US,en;q=0.5
Accept-Encoding	gzip, deflate
Referer	http://localhost:7780/login.html
Content-Type	application/x-www-form-urlencoded
Content-Length	45
Connection	keep-alive
Cookie	auth-example=tgRJwcImfcdDzz1PIspsow/cpn+wJU 6DatIyhOFn6PTYY3TfIbtO8+313vziZ3PCnTQ8hXHvT Sw49bozTRlpZw==
Upgrade-Insecure-Req uests	1

email: userproxy@example.com
password: secret

View: auto ▲   🔽   URLEncoded form

DEBUG　▶ Debug executable 'r‹ ▾　⚙　▣　　mai　⣿ ▶ ⤴ ↧ ↥ ↺ ■　　　　　　　　⧉ ▢ ⋯

VARIABLES

router ▸ src ▸ ⊛ main.rs

```
144             .header(header::LOCATION, "/comments.html")
145             .finish();
146         Ok(res)
147     });
148     Box::new(fut)
149 }
150
151 fn comments(req: HttpRequest<State>) ->
    FutureResponse<HttpResponse> {
152     debug!("/api/comments called");
153     let url = format!("{}/list", req.state().content());
154     let fut = get_req(&url)
155         .map(|data| {
156             HttpResponse::Ok().body(data)
157         });
158     Box::new(fut)
159 }
160
161 fn healthcheck(_req: HttpRequest<State>) -> &'static str {
162     "Router Microservice"
163 }
164
165 #[derive(Debug, Deserialize)]
166 struct Config {
167     address: Option<String>,
168     users: Option<String>,
```

▲ Local
  ▲ req: {...}
      req: <not available>
  ▲ state: (refs:0) <disposed>
    ▸ [raw]: alloc::rc::Rc<router_mi...
    ▸ resource: {prefix:4}
  ▸ url: None
  ▸ Static
  ▸ Global
  ▸ Registers

▲ WATCH

▲ CALL STACK
      _LTactix_web..application..Inner
      _LTactix_web..pipeline..StartMid
      _LTactix_web..pipeline..Pipeline
      _LTactix_web..pipeline..Pipeline
      _LTactix_web..server..h1..Http1D
      _LTactix_web..server..h1..Http1D
      _LTactix_web..server..h1..Http1D

▲ BREAKPOINTS
  ☑ Rust: on panic
  ● ☑ main.rs src   152

PROBLEMS　OUTPUT　DEBUG CONSOLE　⋯　　　LLDB　　▾　⧉ ⊡ ⌃ ✕

    icroservices/router/target/debug/router-microservice' }
(lldb) command script import
'/home/denis/.vscode/extensions/vadimcn.vscode-lldb-1.2.0/adapter'
(lldb) script adapter.run_tcp_session(0,
'eyJzb3VyY2VMYW5ndWFnZXMiOiJsicnVzdCJdfQ==')
Listening on port 34519

⑂ actix-changes* 　↻ ⊗ 0 ⚠ 0　▶ Debug executable 'router-microservice' (router)　RLS　　　　Ln 160, Col 1　Spaces: 4　UTF-8　LF　Rust　☺　🔔 1
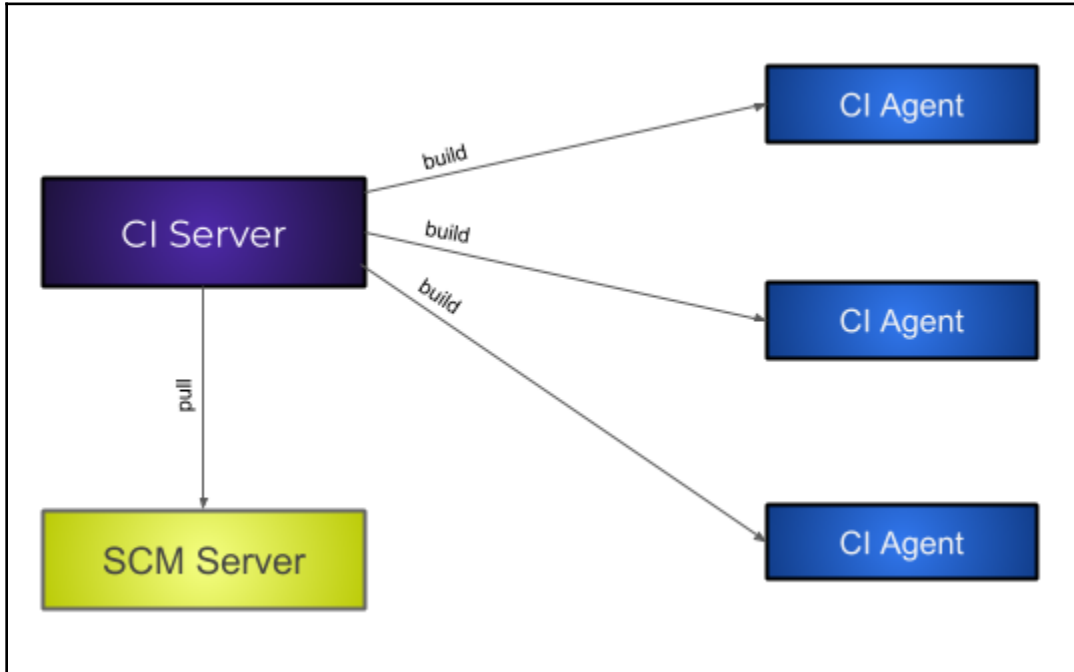
Chapter 14: Optimization of Microservices
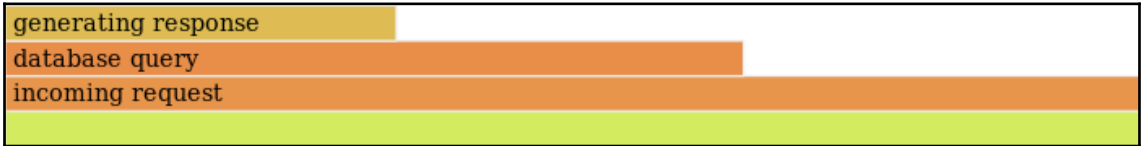
Chapter 15: Packing Servers to Containers

No images

Chapter 16: DevOps of Rust Microservices - Continuous Integration and Delivery

Installation - Gogs ✕ +

ⓘ localhost:10080/install ··· ☑ ☆

Install Steps For First-time Run

If you're running Gogs inside Docker, please read Guidelines carefully before you change anything in this page!

Database Settings

Gogs requires MySQL, PostgreSQL, SQLite3, MSSQL or TiDB.

Database Type * | SQLite3 ▾ |

Path * | data/gogs.db |

The file path of SQLite3 database.
Please use absolute path when you start as service.

Application General Settings

Application Name * | Gogs |

Put your organization name here huge and loud!

Repository Root Path * | /data/git/gogs-repositories |

All Git remote repositories will be saved to this directory.

Sign Up - Gogs - Mozilla Firefox   ✕

File Edit View History Bookmarks Tools Help

Sign Up - Gogs   ✕   +

← → C ⌂   ⓘ localhost:10080/user/sign_up   ⋯ ☑ ☆   ↓ ∥\ ▣ ≡

🔧   Home   Explore   Help   👤 Register   📥 Sign In

Sign Up

Username * | developer

Email * | developer@example.com

Password * | ●●●●●●

Re-Type * | ●●●●●●

533413

Captcha * | 533413

Create New Account

Already have an account? Sign in now!

developer/microservice - Gogs - Mozilla Firefox ✕

⬤ developer/microservice - ✕ | +

← → C ⌂ | ⓘ localhost:10080/developer/microservice | ··· ☑ ☆ | ⬇ ⦀ ⊡ ☰

Dashboard   Issues   Pull Requests   Explore   + ▼   ▦ ▼

🔒 developer / microservice   👁 Unwatch 1   ★ Unstar 1   ⑂ Fork 0

📄 Files   ⓘ Issues 0   �👤 Pull Requests 0   📖 Wiki   ✖ Settings

No Description

| ⓖ 1 Commits | ⑂ 1 Branches | ◌ 0 Releases |

↕ | ⑂ Branch: master ▾ | microservice   New file Upload file | HTTP SSH http://localhost:3000/develop 📋 ⬇

🌼 Denis Kolodin d03a415fdf Initial commit	2 minutes ago
📁 src	d03a415fdf Initial commit	2 minutes ago
📄 .gitignore	d03a415fdf Initial commit	2 minutes ago
📄 Cargo.lock	d03a415fdf Initial commit	2 minutes ago
📄 Cargo.toml	d03a415fdf Initial commit	2 minutes ago

© 2018 Gogs Version: 0.11.85.1225 Page: **42ms** Template: **2ms**   ⊕ English | Website | Go1.11.4

TeamCity First Start

Please review the settings below before proceeding with the first TeamCity start.

TeamCity server stores server configuration settings, project definitions, build results and caches on disk in a **Data Directory**.

Location of the Data Directory: **/data/teamcity_server/datadir**

If you already worked with TeamCity and want to use existing directory or you want to use another location for creating fresh setup, check the documentation to change the directory location.

Proceed

TeamCity 2018.2.1 (build 61078)

Database connection setup

TeamCity server stores builds history and users-related data in an SQL database.ⓘ

Select the database type*: Internal (HSQLDB) ⌄

The internal database suits evaluation purposes only and is not intended for production. We strongly recommend using an external database in a production environment.ⓘ

You can start with the internal database and then migrate the data to an external one after successful evaluation.

Proceed

TeamCity 2018.2.1 (build 61078)

Create Administrator Account

Username

admin

Password

••••••

Confirm password

••••••

Create Account

Login as Super user

Version 2018.2.1 (build 61078)

Agents > Unauthorized (1) — TeamCity - Mozilla Firefox

developer/microservice — × | Agents > Unauthorized (1 — ×   +

localhost:8111/agents.html?tab=unauthorizedAgents

TC   Projects | ▽   Changes   Agents 0   ☐   Build Queue 0   admin | ▽   Administration   ⑦   🔍

Agents   Install Build Agents

Connected 0   Disconnected 0   **Unauthorized 1**   Pools 1   Parameters Report   Matrix   Statistics   Agent Push

There are **1** currently unauthorized agent. Agent licenses left: **3**.

| Authorize | △ rustci_agent_1 Default   Connected   Last communication a few seconds ago
172.20.0.4

⑦ Help   ✉ Feedback   TeamCity Professional 2018.2.1 (build 61078)   License agreement

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Create Project — TeamCity - Mozilla Firefox

developer/microservice — × | Create Project — Team⊂ ×   +

localhost:8111/admin/createObjectMenu.html?projectId=_Root&showMo

TC   Projects | ▽   Changes   Agents 1   ☐   Build Queue 0   admin | ▽   Administration   ⑦   🔍

Administration / ⊞ <Root project>

Create Project

| From a repository URL | 🔧 Manually |

Parent project: *   <Root project>

Repository URL: *   `http://git-server:3000/developer/microservice.git`
                          ○ ▢ ⋈
                          A VCS repository URL. Supported formats: **http(s)://, svn://, git://**, etc. as well as URLs in Maven
                          format. ⑦

Username: `developer`
                          Provide username if access to repository requires authentication.

Password: `●●●●●●`
                          Provide password if access to repository requires authentication.

[Proceed]

← → C ⌂   ⓘ localhost:8111/admin/editRunType.html?id=buildType:Microservice_Buil   ⋯ ♡ ☆   ⬇ �\\\ ▭ ☰

TC   Projects | ▽   Changes   Agents 1 ☐   Build Queue 0   admin | ▽   Administration   ⑦   🔍

Administration / ⬚ \<Root project\> / ⬚ Microservice   [Run | …] [Actions ▾]   Build Configuration Home

☐ Build

General Settings	**New Build Step**
Version Control Settings 1	
Build Steps	**Runner type:**
Triggers 1	
Suggestions 1	
Show more »	

New Build Step

Runner type: [Command Line   ] ▽

Simple command execution

Step name: [Format Check   ]

Optional, specify to distinguish this build step from other steps.

Run: [Custom script   ] ▽

Custom script: *   Enter build script content:

```
cargo fmt -- --check
```

A platform-specific script, which will be executed as a .cmd file on Windows or as a shell script in Unix-like environments.

Created one minute ago by admin
(view history)

[View DSL] ⑦

developer/microservice ×   Build Configuration — Te ×   +

← → C ⌂   ⓘ localhost:8111/admin/editRunType.html?id=buildType:Microservice_Build   ··· ♡ ☆   ⬇ � ▣ ≡

TC   Projects | ▽   Changes   Agents 1 ☐   Build Queue 0   admin | ▽   Administration   ⑦   [🔍]

Administration / ▒ <Root project> / ▒ Microservice   [Run ...] [Actions ▾] Build Configuration Home

☐ Build

General Settings   New Build Step
Version Control Settings 1
                                      Runner type: [Command Line   ] [▽]
Build Step: Command Line   Simple command execution
Triggers 1
                                      Step name: [Build   ]
Show more »   Optional, specify to distinguish this build step from other steps.

                                      Run: [Custom script   ] [▽]

Last edited seconds ago by admin   **Custom script:** *   Enter build script content:
(view history)
                                                                ┌─────────────────────────────┐ ▤
[View DSL ⑦]   │ cargo build   │
                                                                │   │
                                                                │   │
                                                                │   │
                                                                │   │
                                                                │   │
                                                                │   │
                                                                └─────────────────────────────┘
                                                                A platform-specific script, which will be executed as a .cmd file on Windows or as a shell script in
                                                                Unix-like environments.

developer/microservice   ×   Build Configuration — Te   ×   +

← → C ⌂   ⓘ localhost:8111/admin/editBuildRunners.html?id=buildType:Microservice_   ··· ☑ ☆   ⬇ \\\ ⬚ ≡

TC   Projects | ▽   Changes   Agents 1 ☐   Build Queue 0   admin | ▽   Administration ⑦   [   ] 🔍

Administration / 🔡 <Root project> / 🔡 Microservice   [Run ...] [Actions ▾] Build Configuration Home

☐ Build

General Settings

Version Control Settings 1

Build Steps 2

Triggers 1

Show more »

Last edited moments ago by admin
(view history)

[View DSL] ⑦

Build step settings updated.

Build Steps

In this section you can configure the sequence of build steps to be executed. Each build step is represented by a build runner and provides integration with a specific build or test tool. ⑦

[+ Add build step]   [Reorder build steps]   [✎ Auto-detect build steps]

Build Step	Parameters Description	
1. Format Check	Command Line Custom script: cargo fmt -- --check Execute: If all previous steps finished successfully	Edit ☰ ▾
2. Build	Command Line Custom script: cargo build Execute: If all previous steps finished successfully	Edit ☰ ▾

⑦ Help   ✉ Feedback   TeamCity Professional 2018.2.1 (build 61078)   License agreement

developer/microservice ✕ | Microservice / Build > #1 ✕ | +

← → C ⌂ | ⓘ localhost:8111/viewLog.html?buildId=1&buildTypeId=Microservice_Build | ··· ♡ ☆ | ⬇ ⅢⅢ ▯ ☰

TC | Projects |▽ | Changes | Agents 1 ▮ | Build Queue 0 | admin |▽ Administration ⑦ | [🔍]

⊞ Microservice / ☐ Build | [Run ...] [Actions ▾] Edit Configuration Settings |▽

↻ #1 (23 Jan 19 21:06) |▽

Overview | Changes | **Build Log** | Parameters | Artifacts

Tree view | Tail | ⬇ Download full build log (~5.04 KB) | .zip

[⬆] [⬇] | View: [All messages ▾] ☐ Console view | ☑ Repeat block names

```
[21:06:43]   The build is removed from the queue to be prepared for the start
[21:06:43] ▶ Collecting changes in 1 VCS root
[21:06:44]   Starting the build on the agent rustci_agent_1
[21:06:51]   Clearing temporary directory: /opt/buildagent/temp/buildTmp
[21:06:51] ▶ Publishing internal artifacts  (1s)
[21:06:51]   Will perform clean checkout. Reason: Checkout directory is empty or doesn't exist
[21:06:51]   Checkout directory: /opt/buildagent/work/6bb39fb1710c6cb
[21:06:51] ▶ Updating sources: auto checkout (on server)  (8s)
[21:07:00] ▶ Step 1/2: Format Check (Command Line)  (1s)
[21:07:02] ▼ Step 2/2: Build (Command Line)  (running for 33s)
[21:07:02]     [Step 2/2] Starting: /opt/buildagent/temp/agentTmp/custom_script7816632993483062962
[21:07:02]     [Step 2/2] in directory: /opt/buildagent/work/6bb39fb1710c6cb
[21:07:02]     [Step 2/2]    Updating crates.io index
```

↻ Running...

⑦ Help | ✉ Feedback | TeamCity Professional 2018.2.1 (build 61078) | License agreement

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Chapter 17: Bounded Microservices with AWS Lambda
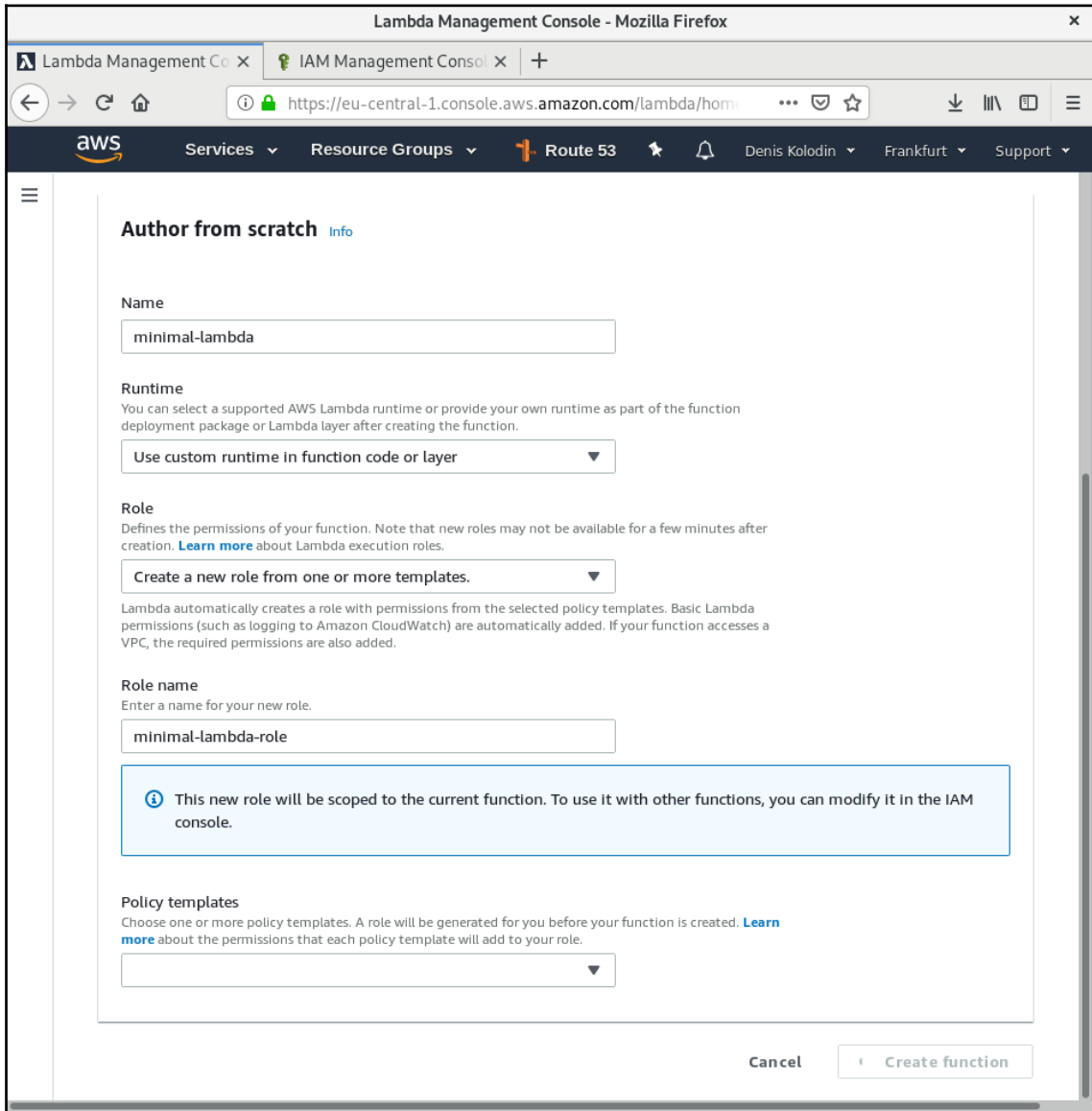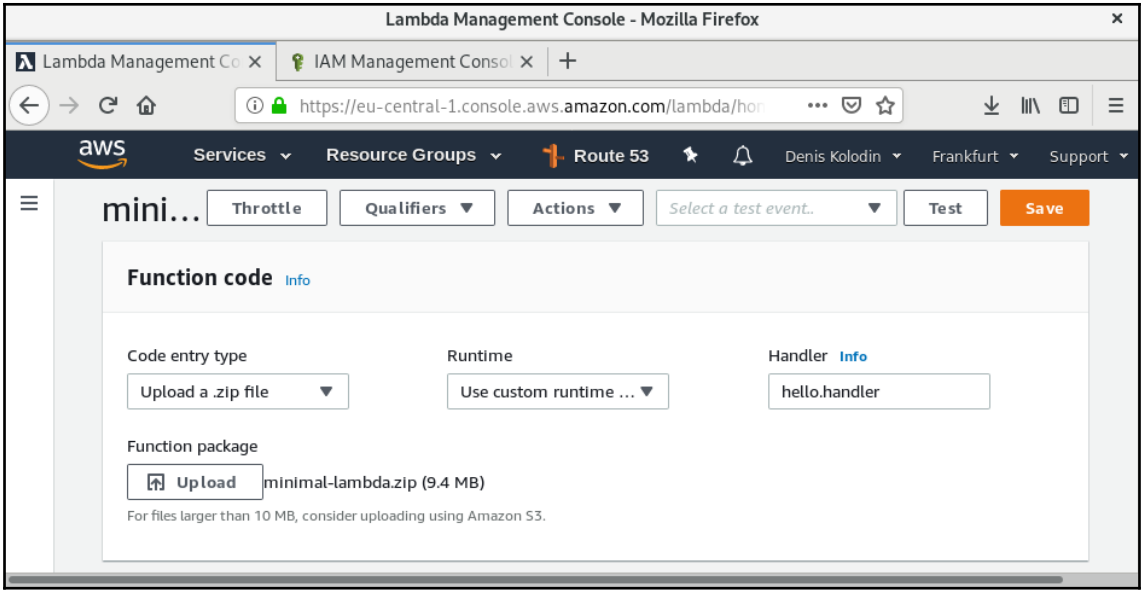
← → C ⌂   ⓘ 🔒 https://eu-central-1.console.aws.amazon.com/lambda/home?   ••• ☑ ☆   ⭳ ⫙ ▥ ☰

Configure test event   ✕

A function can have up to 10 test events. The events are persisted so you can switch to another computer or web browser and test your function with the same events.

● Create new test event
○ Edit saved test events

Event template

Hello World   ▼

Event name

uniform

```
1 ▾ {
2     "distribution": "uniform",
3 ▾  "parameters": {
4       "start": 0,
5       "end": 100
6     }
7 }
```

Cancel   **Create**

Feedback   English (US)   © 2008 - 2019, Amazon Web Services, Inc. or its affiliates. All rights reserved.   Privacy Policy   Terms of Use

Wild Rydes - Mozilla Firefox

Wild Rydes

rust-sls-aws.s3-website-us-east-1.amazonaws.co

Set Pickup   Account ▾

Welcome! Click the map to set your pickup location.

You are authenticated. Click to see your auth token.

Shadowfax, your White unicorn, is on his way.

Shadowfax has arrived. Giddy up!

Capitol Hill

Seattle

Yesler Terrace

City of Seattle, County of King, Esri, HERE, DeLorme, USGS, Bureau of Land Management, EPA, NPS, USDA   Powered by Esri

Wild Rydes   ×   AWS Management Cons   ×   User Pools - Amazon Cog   ×   Lambda Management Co   ×   CloudWatch Managemen   ×   +

https://console.aws.amazon.com/cloudwatch/home?region=us-east-1#logEventViewe

CloudWatch

Dashboards

Alarms   ◀

  ALARM   0

  INSUFFICIENT   0

  OK   0

  Billing

Events

  Rules

  Event Buses

Logs

  Insights

Metrics

Favorites

CloudWatch > Log Groups > /aws/lambda/rust-sls-dev-lambda_1 > 2019/01/25/[$LATEST]91ac2832681c45fdaf1f8554faede3ef

Expand all ● Row ○ Text   ↻   ⚙   ?

	Time (UTC +00:00)	Message
	2019-01-25	
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::client::connect::http] connecting to 127.0.0.1:9001
▸	22:30:06	2019-01-25 22:30:06 DEBUG [tokio_reactor::background] starting background reactor
▸	22:30:06	START RequestId: 1d9abfd1-905a-49d4-bd87-d9f493bfba9d Version: $LATEST
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::proto::h1::io] flushed 74 bytes
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::proto::h1::io] read 5886 bytes
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::proto::h1::io] parsed 7 headers
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::proto::h1::conn] incoming body is chunked encoding
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::proto::h1::decode] incoming chunked header: 0x153D (5437 bytes)
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::proto::h1::conn] incoming body completed
▸	22:30:06	2019-01-25 22:30:06 DEBUG [hyper::client::pool] pooling idle connection for "http://127.0.0.1:9001"
▸	22:30:06	2019-01-25 22:30:06 INFO [lambda_runtime::runtime] Received new event with AWS request id: 1d9abfd1-
▸	22:30:06	2019-01-25 22:30:06 DEBUG [lambda_1] USERNAME: fe7e9414-8eaf-4046-a986-5c6997287ae4
▸	22:30:06	2019-01-25 22:30:06 DEBUG [lambda_1] Finding unicorn for 47.60572939423103, -122.33042770385534
▸	22:30:06	2019-01-25 22:30:06 DEBUG [rusoto_core::signature] Creating request to send to AWS.
▸	22:30:06	2019-01-25 22:30:06 DEBUG [rusoto_core::request] Full request:
▸	22:30:06	method: POST
▸	22:30:06	final_uri: https://dynamodb.us-east-1.amazonaws.com/
▸	22:30:06	payload: {"Item":{"User":{"B":null,"S":"fe7e9414-8eaf-4046-a986-5c6997287ae4"},"RideId":{"B":null,"S":"45c
▸	22:30:06	Headers: