



AWS
re:Invent

ROB301

Running tests in simulation with AWS RoboMaker

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Engineering
iRobot

Agenda

Intro to AWS RoboMaker

Testing in Simulation with AWS RoboMaker

Running tests in Simulation for CI/CD on AWS

Demo

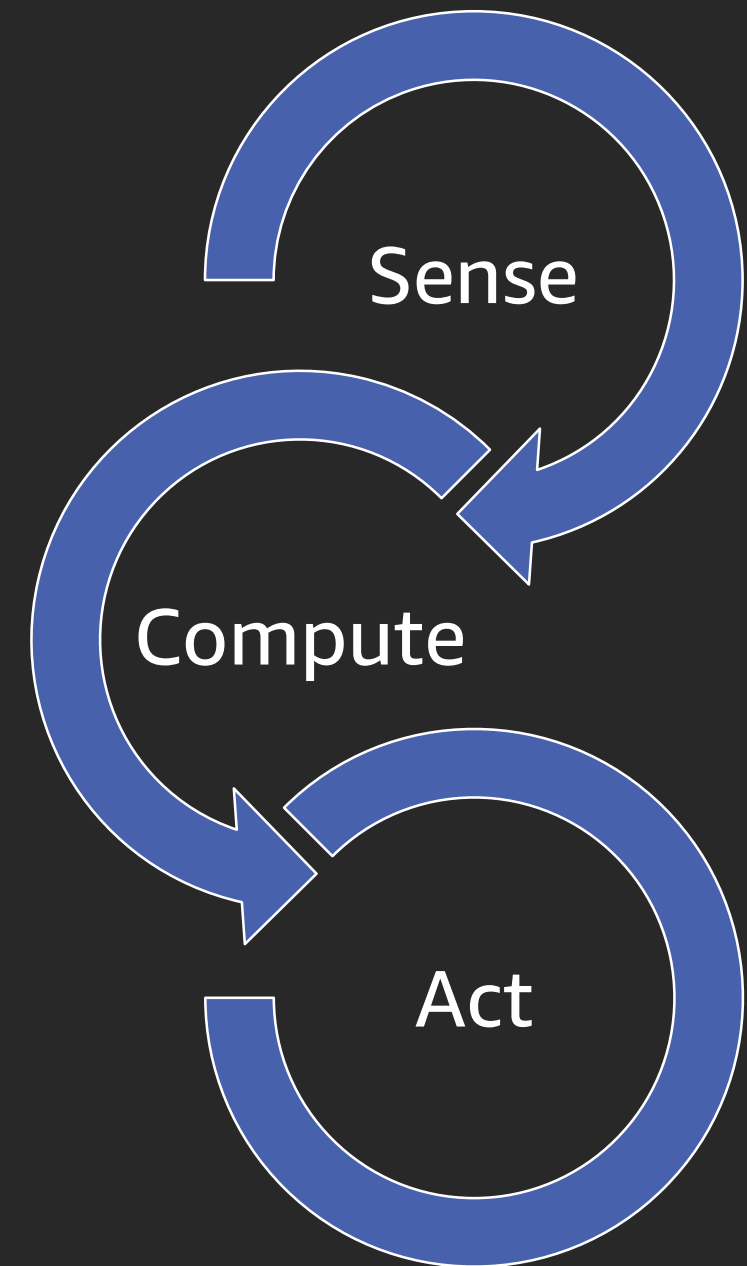
iRobot case study

Let's talk

Join us in the Robotics Networking Lounge at Aria on *Thursday (12/5)*,
from *8:00 a.m. to 6:00 p.m.*

What is a robot

A robot is an autonomous machine capable of sensing its environment. It performs computations to make decisions and it performs actions in the real world.



Robot landscape



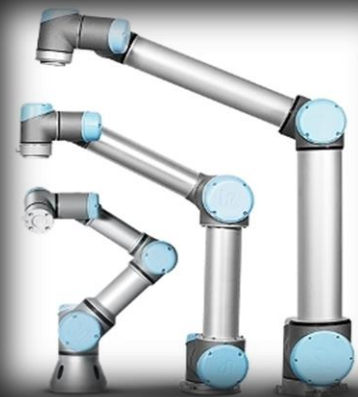
International Space Station



Autonomous walker



Drones



Robotic arms

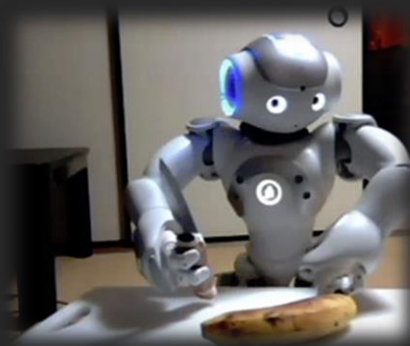


Self-driving vehicles

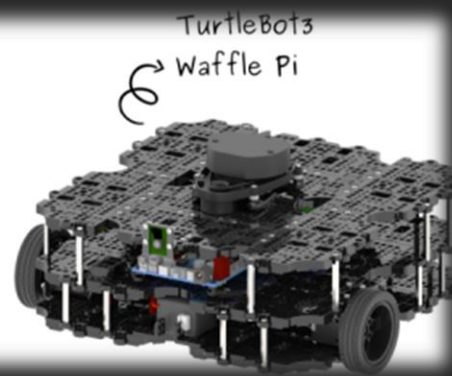


Water

Education

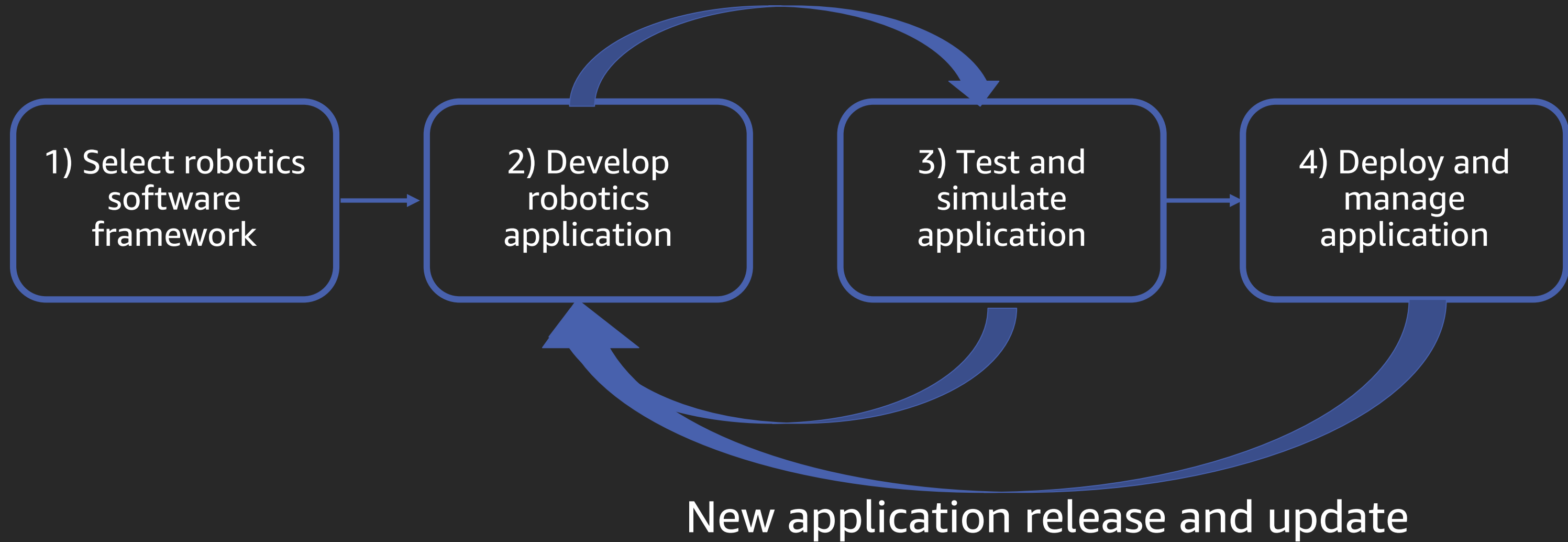


Home



Rover

Robotic development cycle



Robot Operating System (ROS) primer

- Most widely used software framework for teaching and learning about robotics—over 16 million .deb (Linux Debian) packages downloaded in 2018, a 400% increase since 2014
- Founded in Stanford labs more than 10 years ago, now managed by the Open Source Robotics Foundation (OSRF)
- Global open-source community supports two products—Robot Operating System (ROS) and Gazebo



ROS

A set of software libraries and tools, from drivers to algorithms, that help developers build robot applications

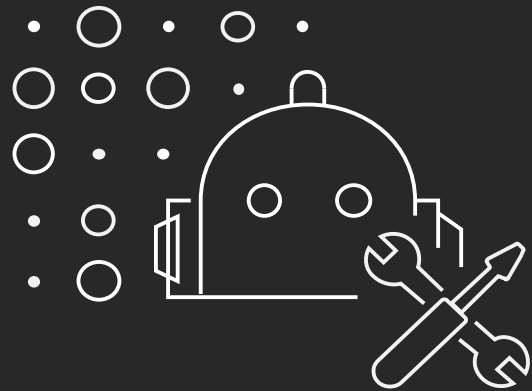


Gazebo

Robust physics engine, high-quality graphics, and programmatic and graphical interfaces to help developers simulate robots

AWS RoboMaker service suite

A service that makes it easy for developers to **develop**, **test**, and **deploy** robotics applications, as well as build robotics functions using cloud services



Cloud extensions for
ROS

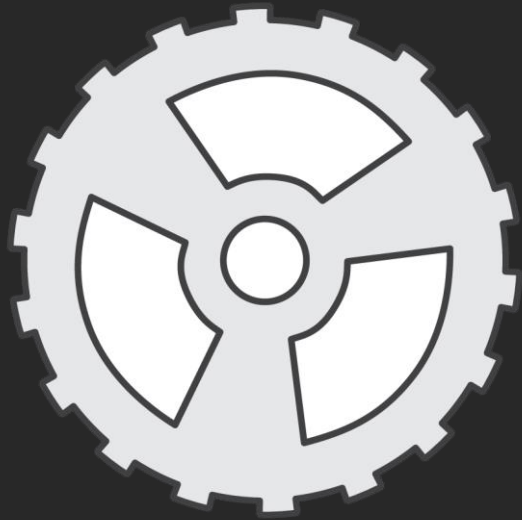


Simulation



Fleet
management

AWS RoboMaker Managed Simulation Service



Managed API
Gazebo, Rviz, rqt

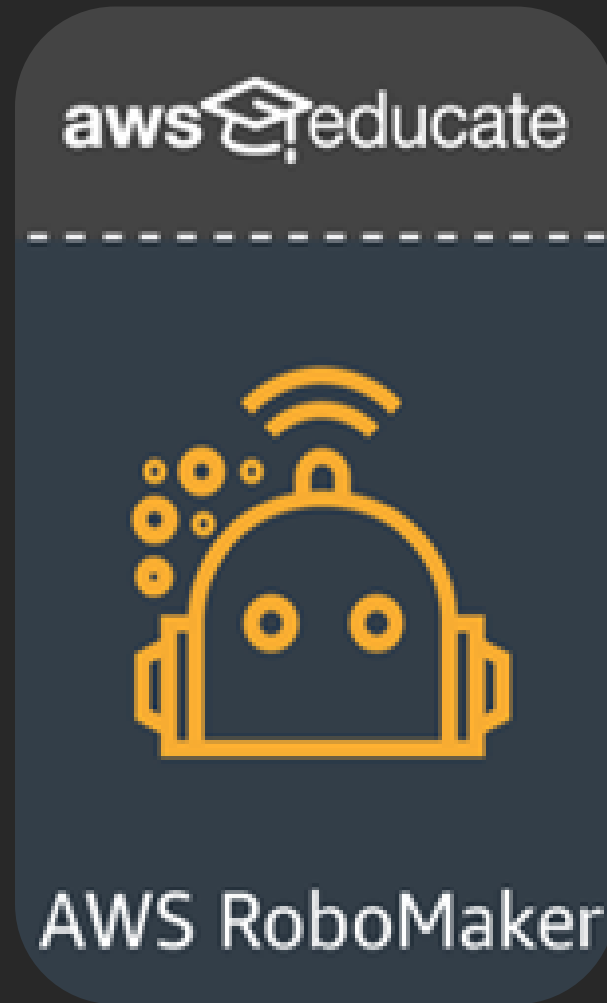


Logging

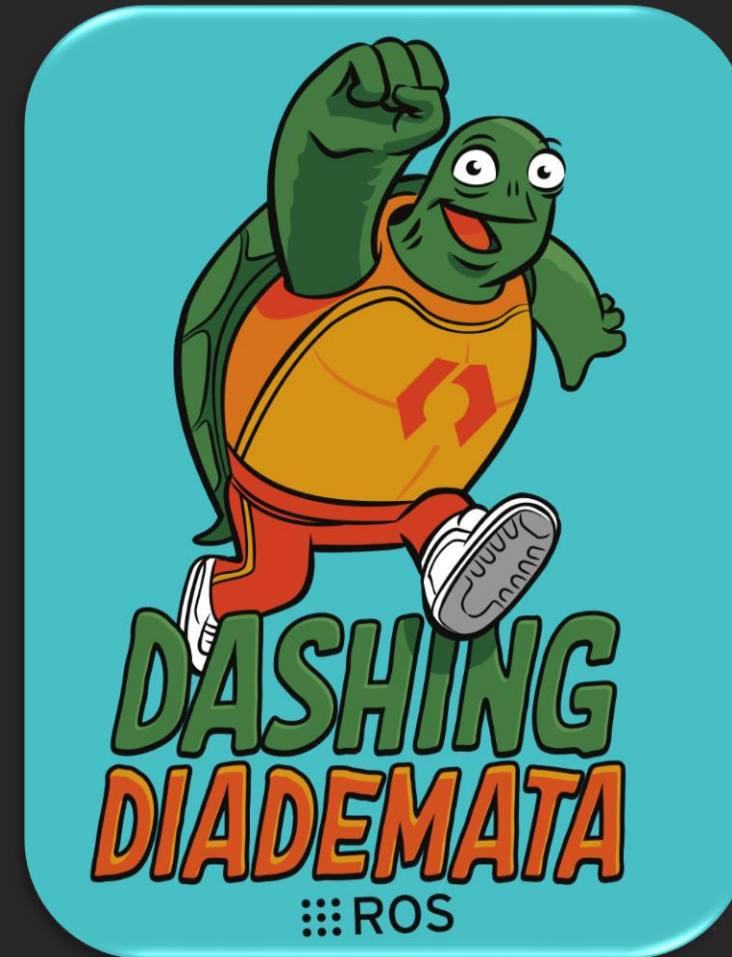


Pay-as-you-go

AWS RoboMaker contributions



Education



Opensource

Testing in simulation for robotic development

How does testing in simulation help

- Safety
- Repeatability
- Regression test behaviors, A/B testing
 - Waves of long running tests to asses quality metrics
 - Performance testing, how well am I doing over time
- Parallel tests, much faster than real time
- Scenarios/randomization

Enabling CI/CD for robots

AWS RoboMaker enables testing in simulation to support CI/CD use cases for robotic development



Personas



DevOps engineer

- Build testing tools to automate running simulations
- Build testing tools to automate test result parsing, validation and reporting

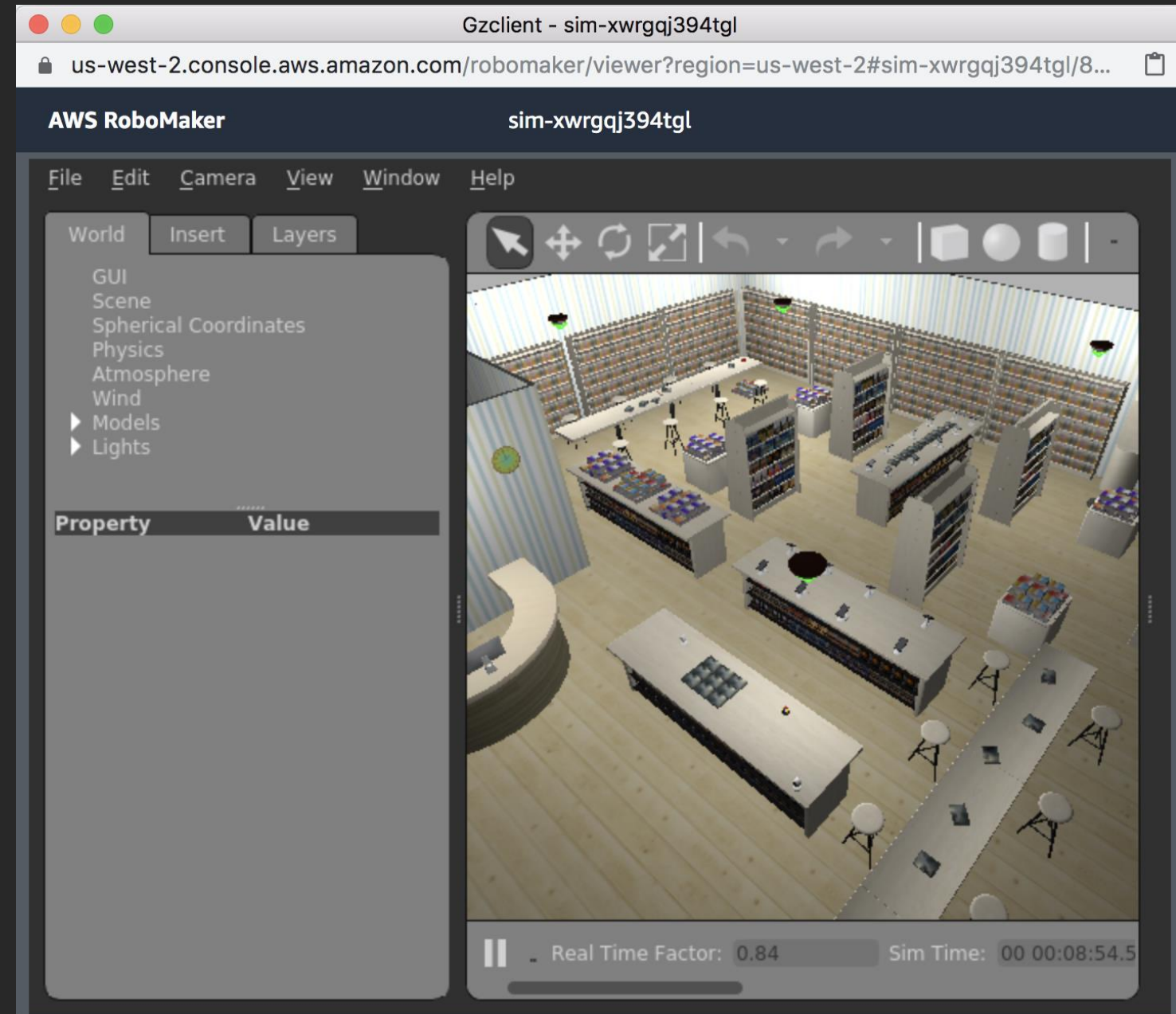
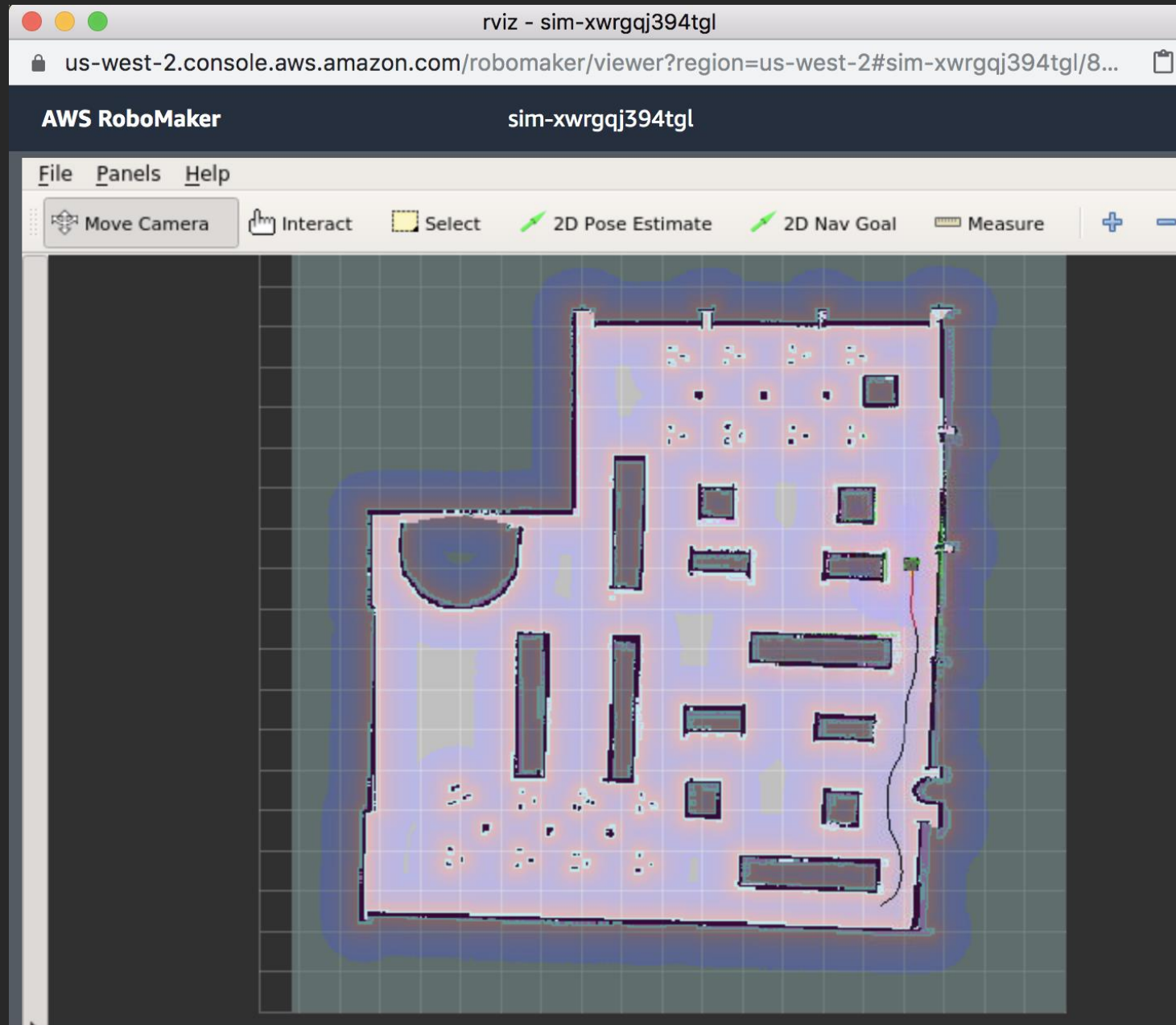


QA engineer and test

- Run automated tests and log test failures
- Look at test metrics over time to audit stability/quality metrics

Building CI/CD with testing in simulation on AWS

Sample application



Developer Tools

**CodePipeline**

▶ Source • CodeCommit

▶ Build • CodeBuild

▶ Deploy • CodeDeploy

▼ Pipeline • CodePipeline

Getting started

Pipelines

🔍 Go to resource

💬 Feedback

Developer Tools

AWS CodePipeline

visualize and automate
the different stages of
your software release
process

AWS CodePipeline is a continuous integration and continuous delivery service for fast and reliable application and infrastructure updates. CodePipeline builds, tests, and deploys your code every time there is a code change, based on the release process models you define..

Create AWS CodePipeline pipeline

Get started with AWS CodePipeline by creating your first continuous delivery and continuous integration pipeline.

[Create pipeline](#)

Pricing (US)

Each active
pipeline**

\$1/month*

How it works



Feedback



English (US)

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Developer Tools

**CodeBuild**

► Source • CodeCommit

▼ Build • CodeBuild

Getting started

Build projects

Build history

Account metrics

► Deploy • CodeDeploy

► Pipeline • CodePipeline

🔍 Go to resource

💬 Feedback

Developer Tools

AWS CodeBuild

Build and test code with elastic scaling. Pay only for the build time you use.

AWS CodeBuild is a fully managed continuous integration service that compiles source code, runs tests, and produces software packages that are ready to deploy. With CodeBuild, you don't need to provision, manage, and scale your own build servers. CodeBuild scales continuously and processes multiple builds concurrently, so your builds are not left waiting in a queue.

Create AWS CodeBuild project

Get started with AWS CodeBuild by creating your first build project.

[Create project](#)

Pricing (US)

Using AWS Lambda to run multiple simulations



We wrote a **simple AWS Lambda function** that will launch multiple simulations based on a defined set of **test scenarios**

Test parameters in this example are implemented as a set of **environment variables** passed along to the simulation

```
{
  "wait": 5,
  "scenarios": {
    "QuickNav": {
      "robotEnvironmentVariables": {
        "ROS_AWS_REGION": "us-west-2"
      },
      "simEnvironmentVariables": {
        "ROS_AWS_REGION": "us-west-2",
        "TURTLEBOT3_MODEL": "waffle_pi",
        "NAVIGATION_SUCCESS_COUNT": "1"
      }
    },
    "MultiNav": {
      "robotEnvironmentVariables": {
        "ROS_AWS_REGION": "us-west-2"
      },
      "simEnvironmentVariables": {
        "ROS_AWS_REGION": "us-west-2",
        "TURTLEBOT3_MODEL": "waffle_pi",
        "NAVIGATION_SUCCESS_COUNT": "4"
      }
    }
  }
}
```

<https://github.com/aws-robotics/aws-robomaker-simulation-launcher>

Test simulations

- Each simulation job invoked corresponds to one test
- Automatically cancel the job when the tests either fail or are completed
 - Only pay (up to the nearest minute) for the specific simulation compute requirements
- Self-tag the simulation job with the test results for analysis as part of the CI pipeline

Utilities for reporting results

```
class SimulationUtils():
```

```
    """
```

```
    This class provides methods to interact with the  
    robomaker simulation service. You can cancel jobs and tag jobs.
```

```
    """
```

```
def cancel_job(self):
```

```
    rospy.wait_for_service('/robomaker/job/cancel')
```

```
    requestCancel = rospy.ServiceProxy('/robomaker/job/cancel', Cancel)
```

```
    response = requestCancel()
```

```
    if response.success:
```

```
        self.is_cancelled = True
```

```
        rospy.loginfo("Successfully requested cancel job")
```

```
    else:
```

```
        rospy.logerr("Cancel request failed: %s", response.message)
```

```
def set_tag(self, name, value):
```

```
    rospy.wait_for_service('/robomaker/job/add_tags')
```

```
    requestAddTags = rospy.ServiceProxy('/robomaker/job/add_tags', AddTags)
```

```
    tags = ([Tag(key=name, value=value)])
```

```
    response = requestAddTags(tags)
```

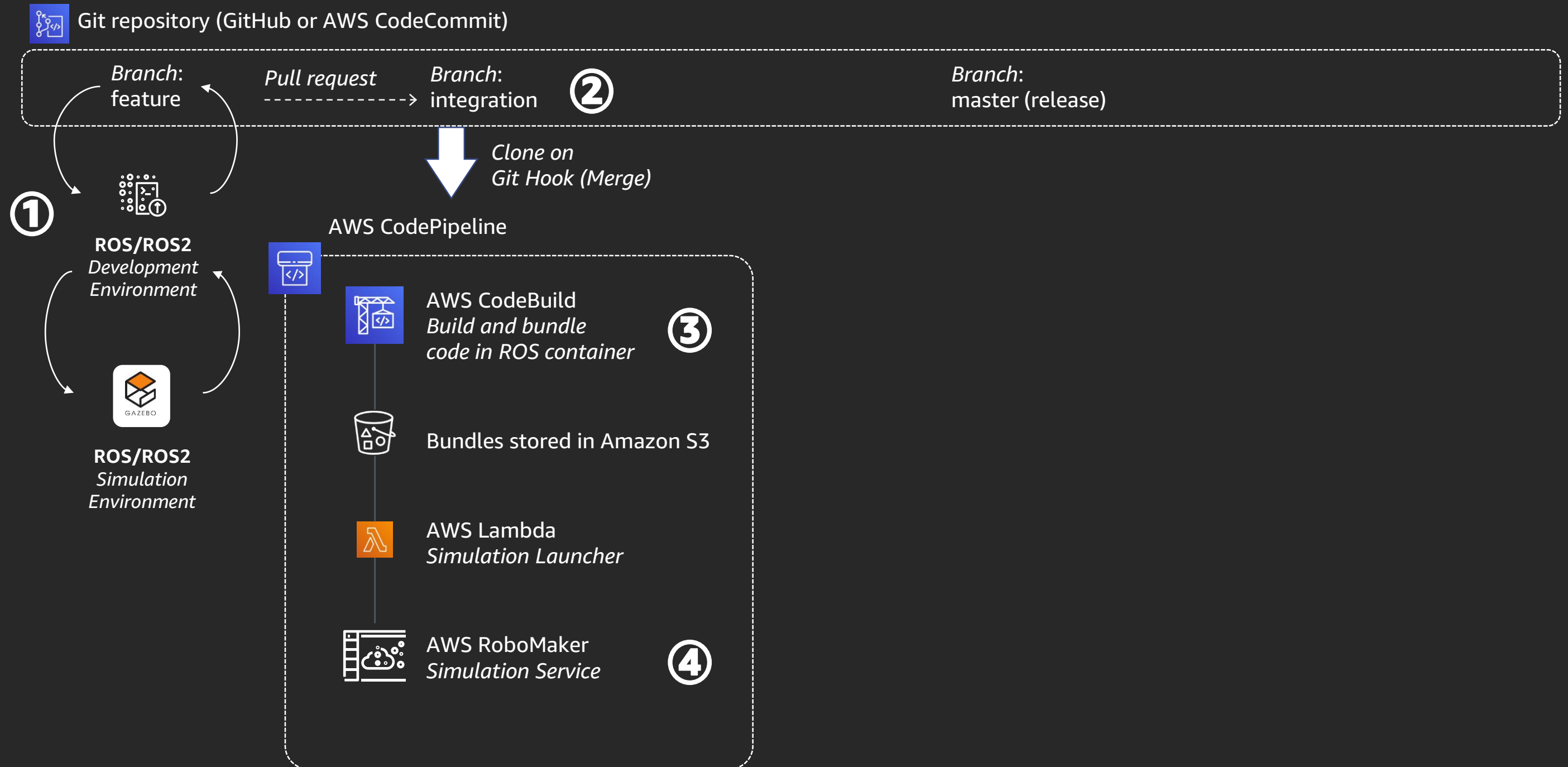
```
    if response.success:
```

```
        rospy.loginfo("Successfully added tags: %s", tags)
```

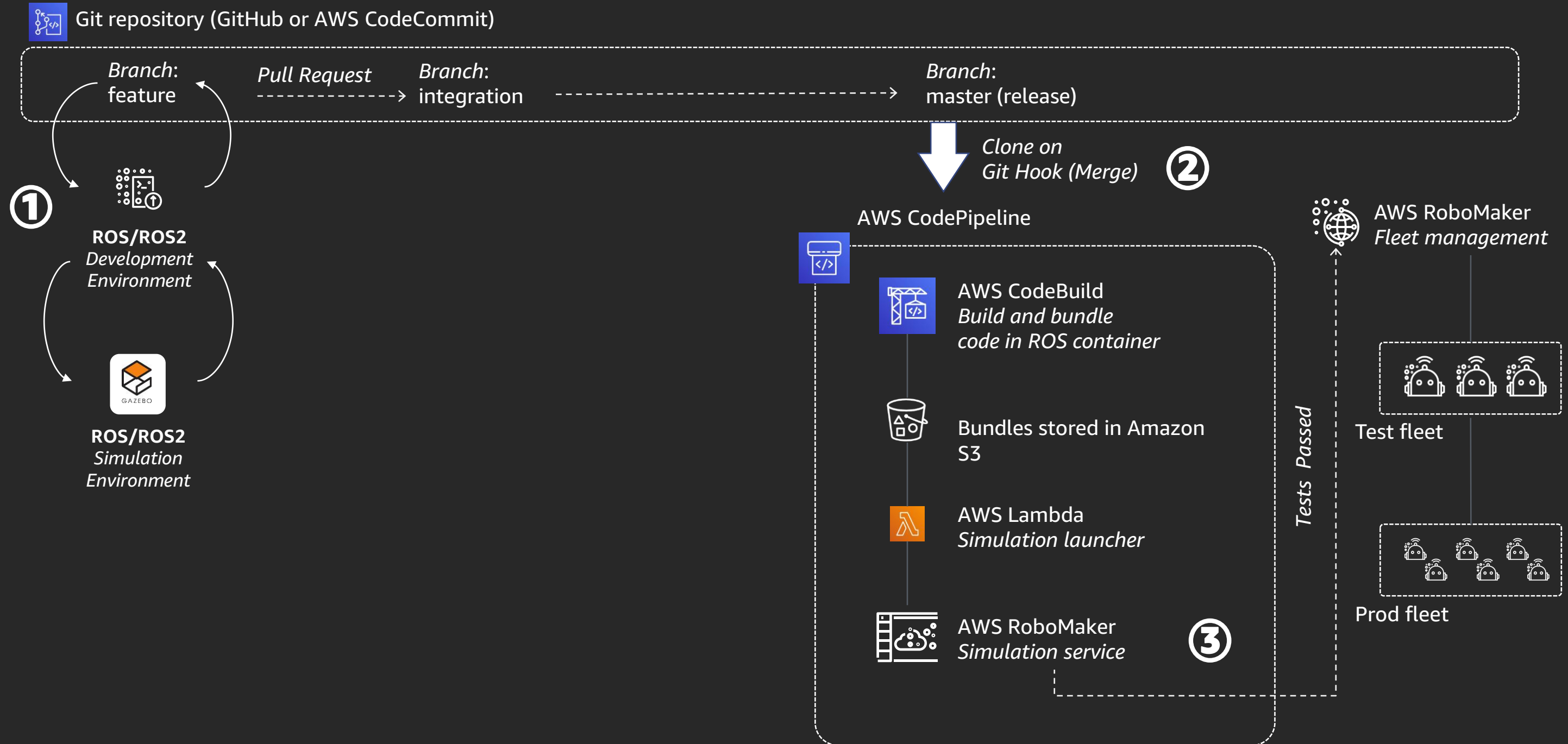
```
    else:
```

```
        rospy.logerr("Add tags request failed for tags (%s): %s", tags, response.message)
```

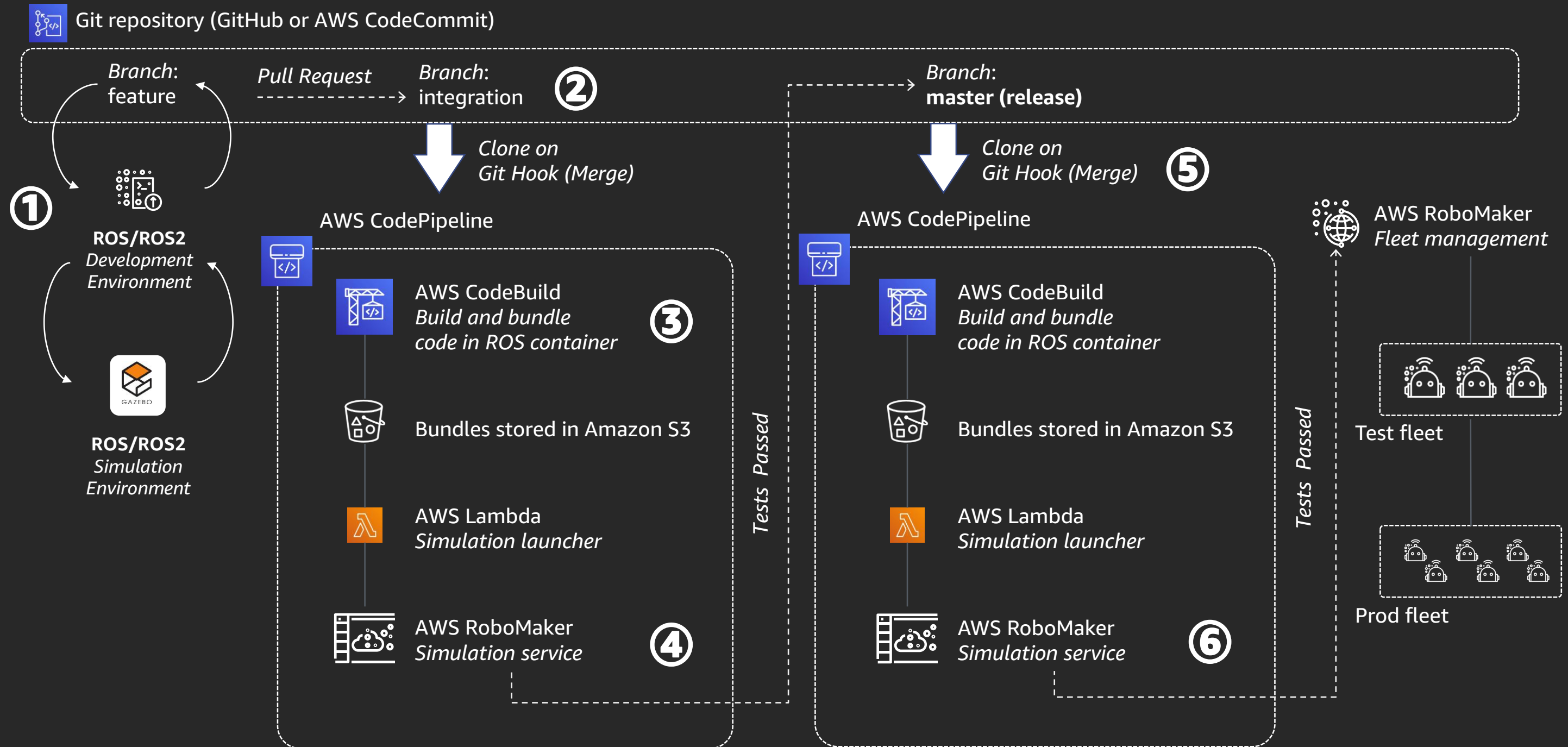
Automated simulations with AWS CodePipeline



Automated deployments with CodePipeline



Architecture overview



Demo

Go to Anything (% P)

Environment

TestSuitePOCRol - /home/ubuntu/enviro

.c9

aws-robomaker-sample-application-cloudv

aws-robomaker-sample-application-cloudv

build

install

log

roboMakerLogs

rol

notes.txt

README.md

roboMakerSettings.json

Collaborate

Outline

Debugger

bash - "colcon build | x +

0 of 0 < > A A Replace With Replace Replace All

b9TestUser:~/environment/aws-robomaker-sample-application-cloudwatch (lafranch-test-suite-poc) \$ git status

iRobot case study

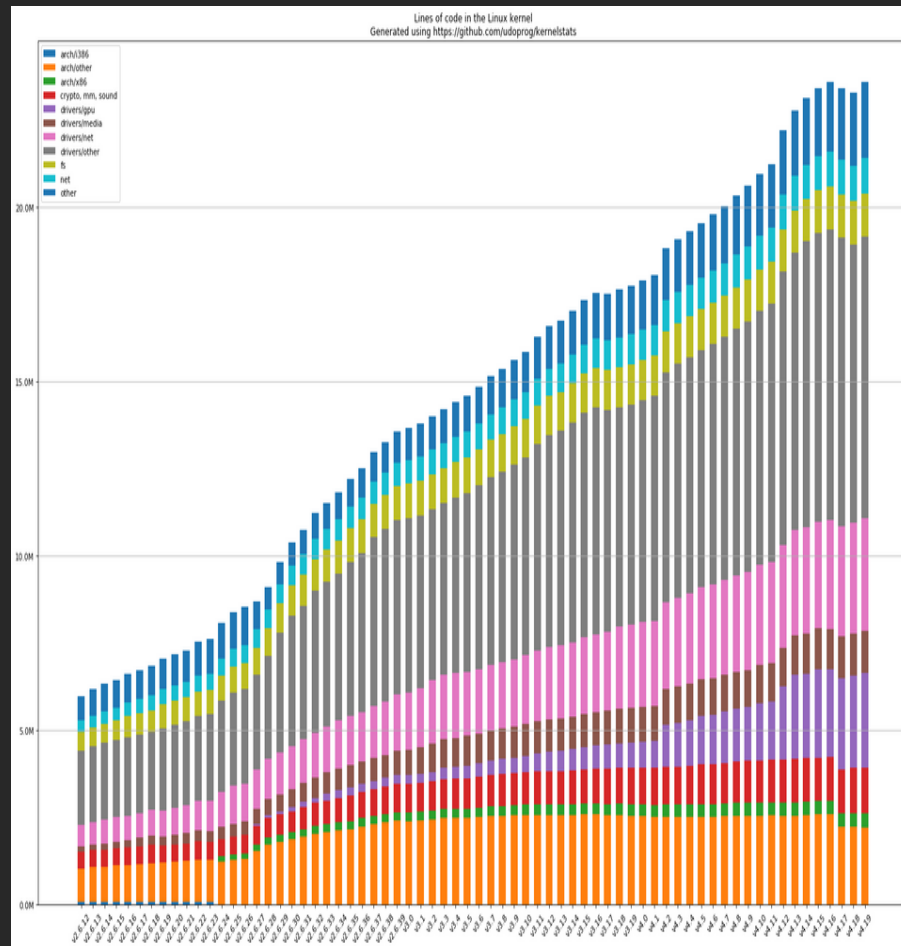


TM

Why do we need simulation at scale

Bigger problems, need better tools

More code



More reuse



Harder to test



From 10's of thousands to millions of lines of code in our products

A brief history of testing



A brief history of testing at iRobot

- Test labs
 - test components, reliability, performance
- Lots of physical robots available
 - Robots all over our facility
- Beta testing
 - Users love our products

War stories

Several robots on a common base

Physical tests compete for time, space, and resources across products

Hardware versions play a part as well

Some simulation exist

Created and maintained by developers

Baseline testing takes about six weeks



Simulation can help

Fastest and cheapest way to test

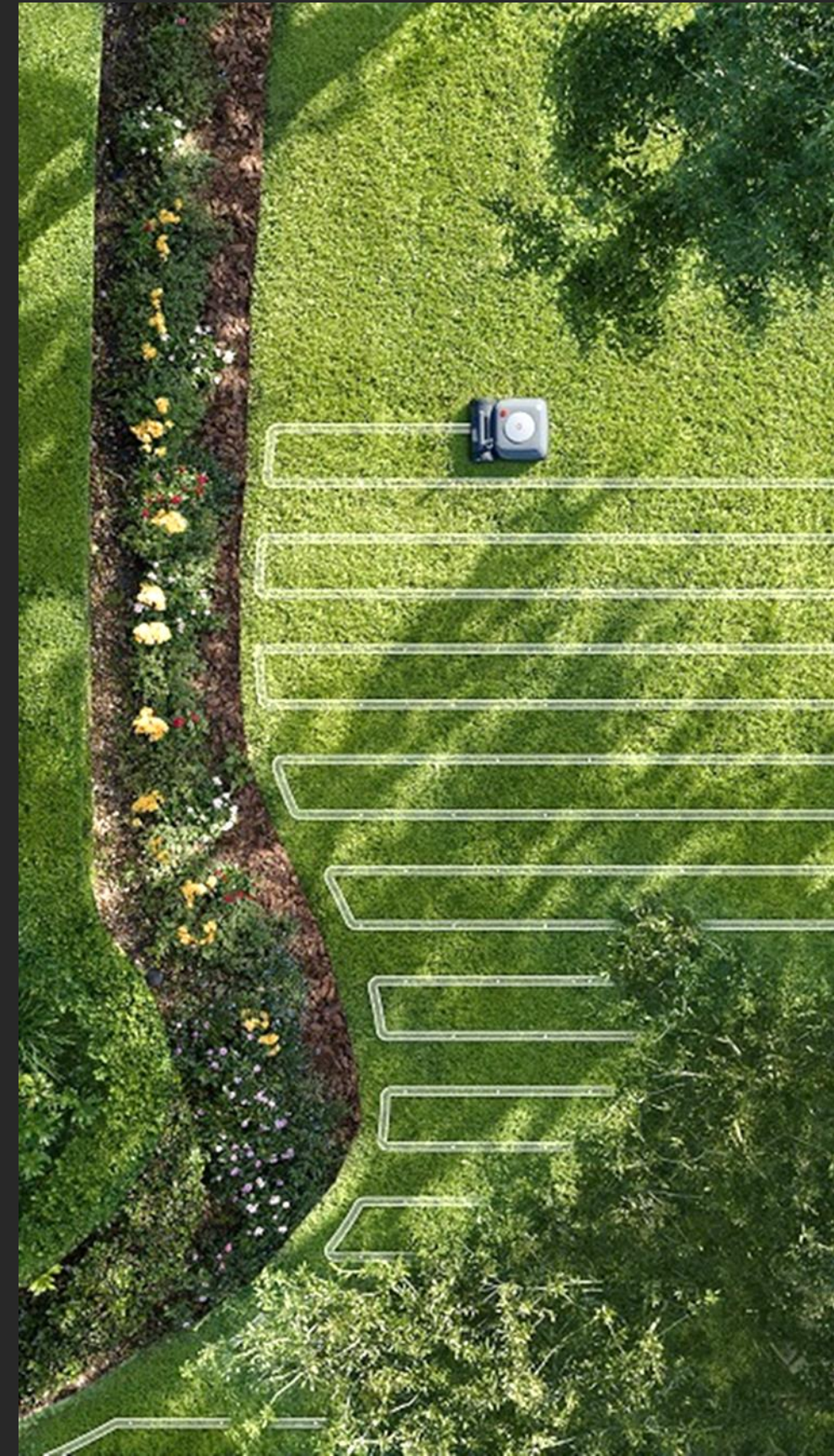
Run 20 simulated missions instead of one physical

Run across several products at once

Speed feedback from weeks to minutes

Provide higher quality code to physical and user tests

Fix more environment interactions in physical and user testing



Why AWS RoboMaker

Leverage standards of ROS and Gazebo for simulation

ROS out-of-box components help us get started

Easier to find developers/partners

Already using AWS for elements of the build and telemetry systems

Speeds simulation development

Increase stability, expand scope



Teamwork

Lots of issues

Daily standups with AWS team

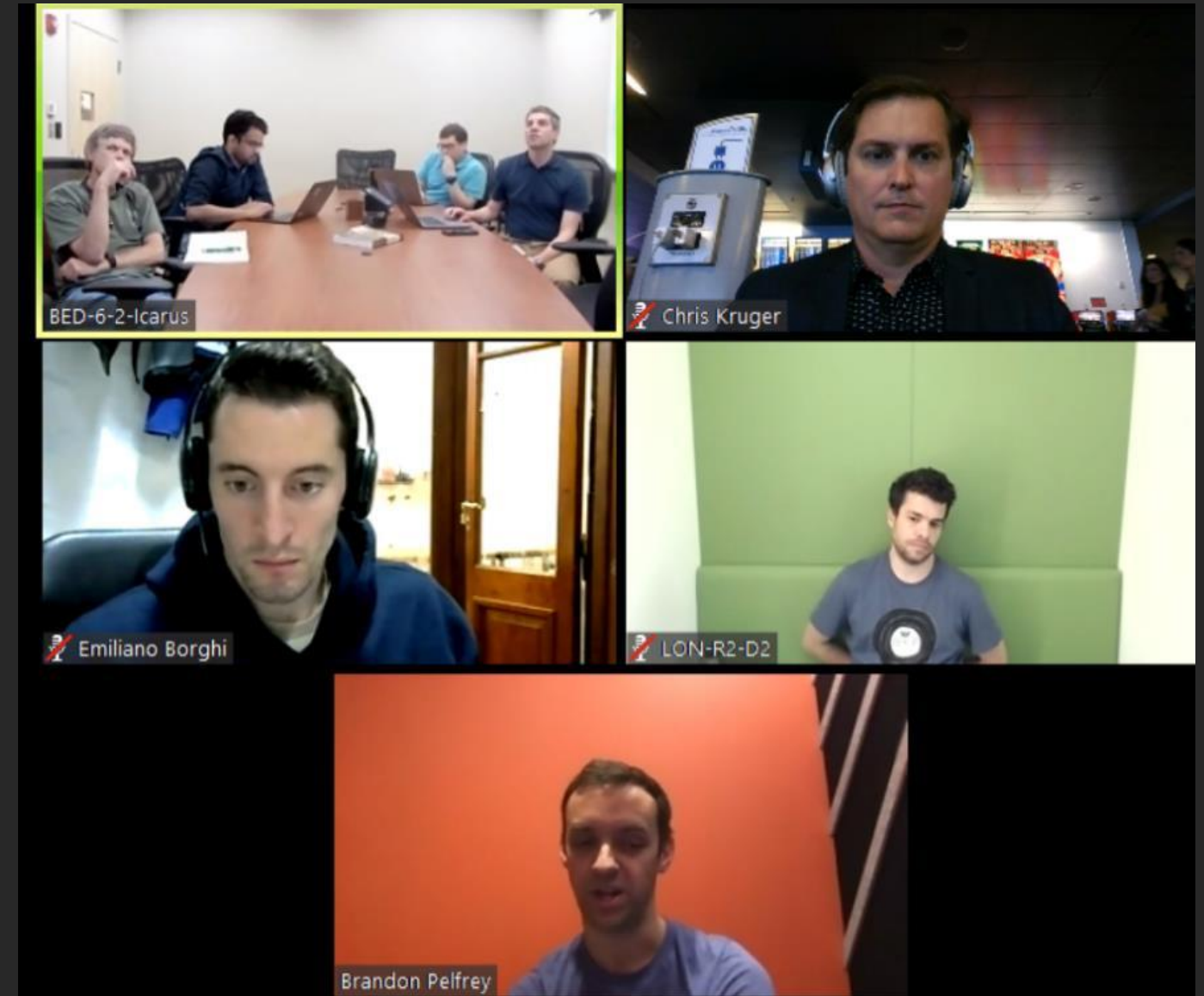
Optimized robot firmware

Move to latest Gazebo

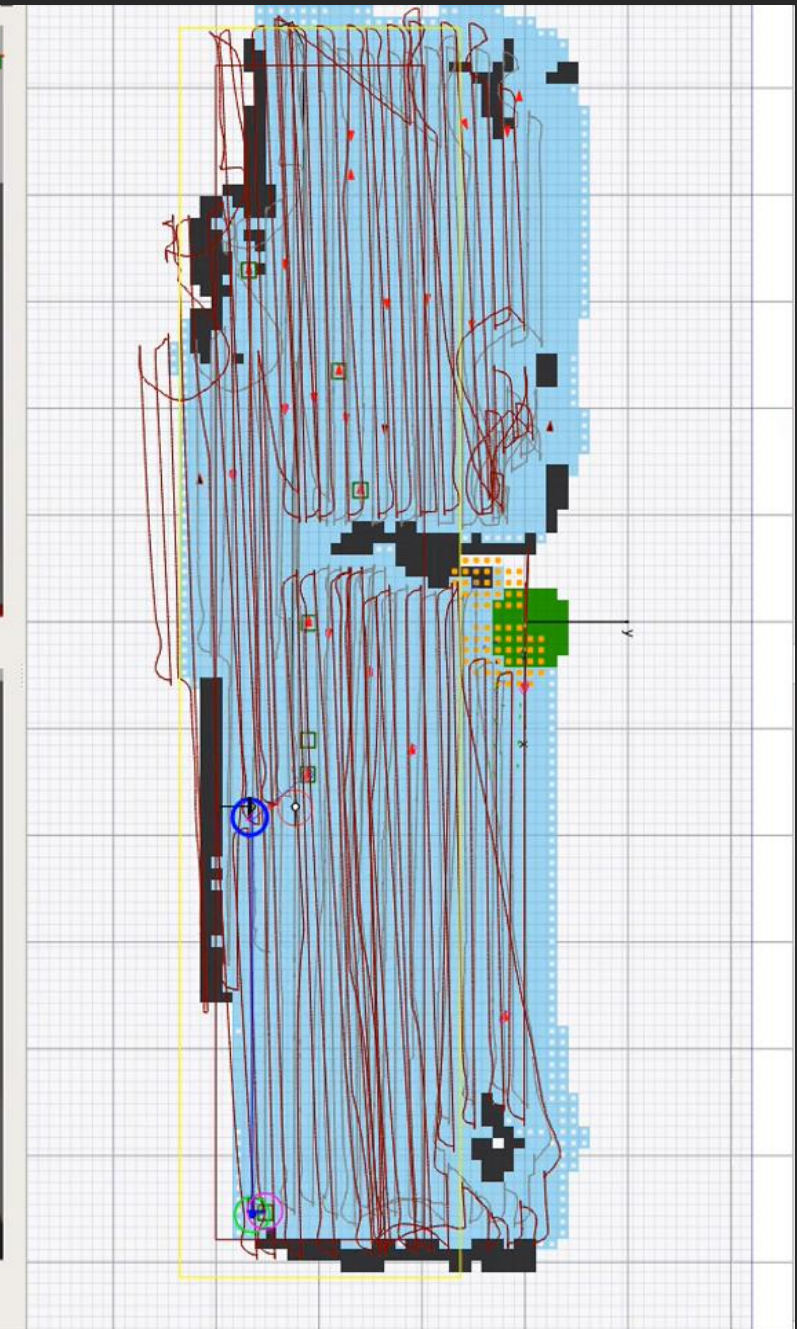
Update build tools

AWS RoboMaker sets up new services

In a couple of weeks, Roomba is running in RoboMaker

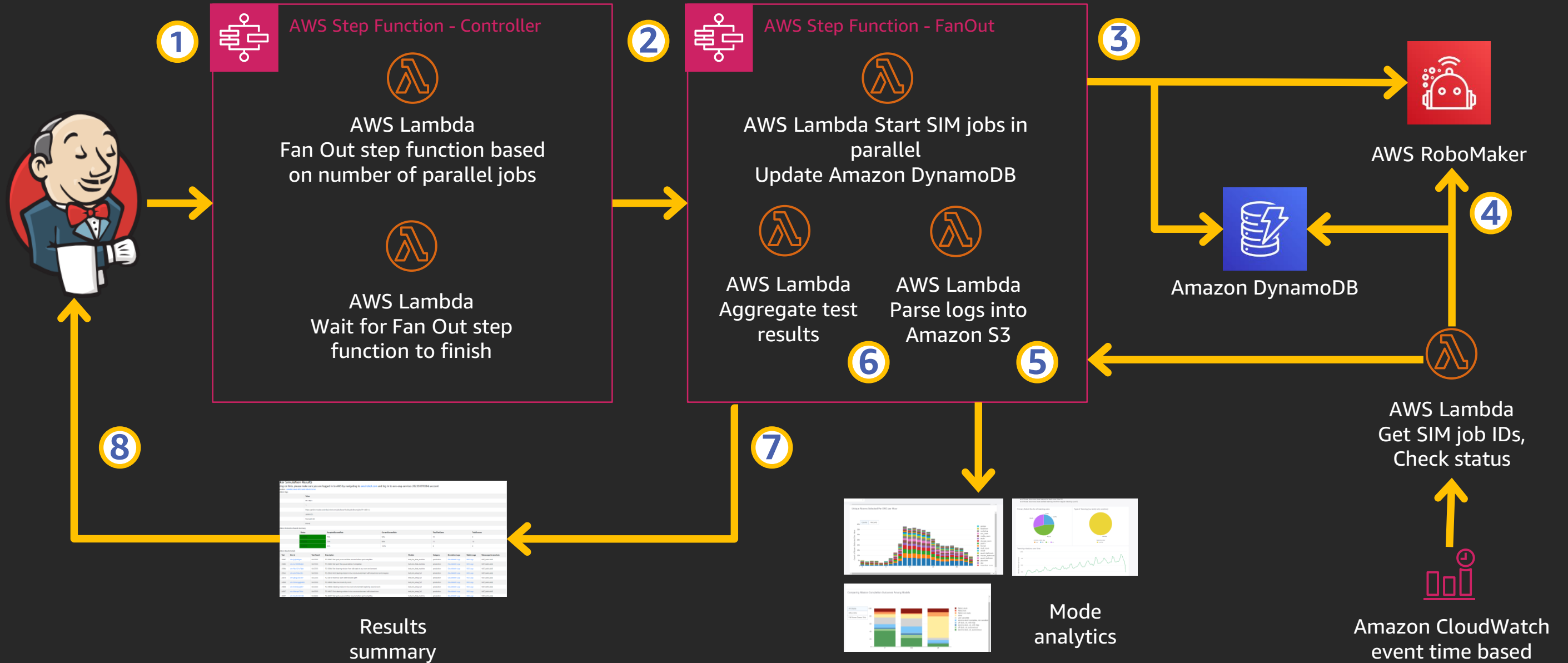


It's working



iRobot simulation flow

Floorcare gate



It's working

Within 3 months

5,000 missions a month

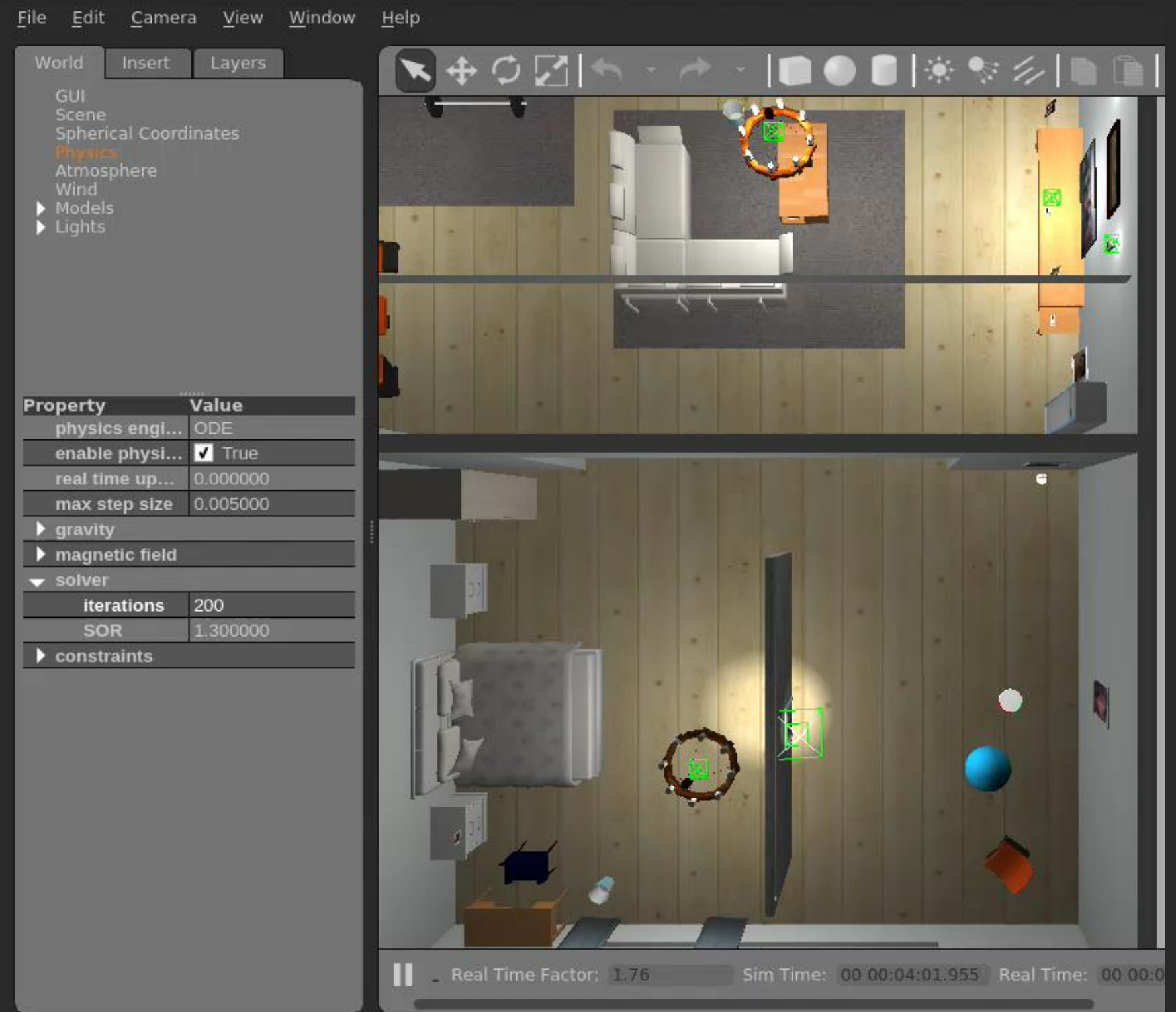
Gating submissions

Catching issues

Higher-quality mainline

Docker for local runs

Developers want more



Realized benefits

Simulation does not test everything

Faster feedback and scalability

Like having 20 extra testers when we need them

Managed services allow us to focus



www.irobot.com/about-irobot/careers



Thank you!



Please complete the session
survey in the mobile app.