

AWS Lambda



**DE HOGESCHOOL
MET HET NETWERK**

Elfde-Liniestraat 24, 3500 Hasselt, www.pxl.be



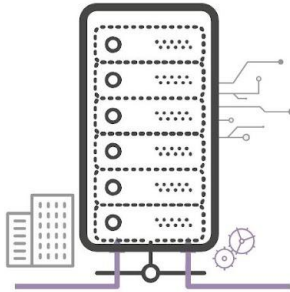
AWS Lambda

Evolving to serverless

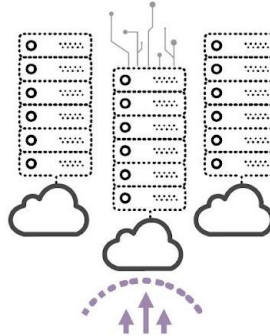
**Physical Servers
in Datacenters**



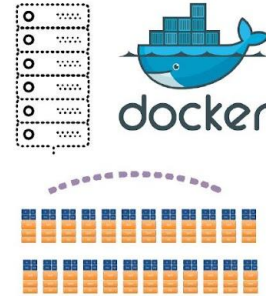
**Virtual Servers
in Datacenters**



**Virtual Servers
in the Cloud**



**Containers
in the Cloud**



**Serverless with
the Cloud**



Evolving to serverless



**No servers to provision
or manage**



Never pay for idle

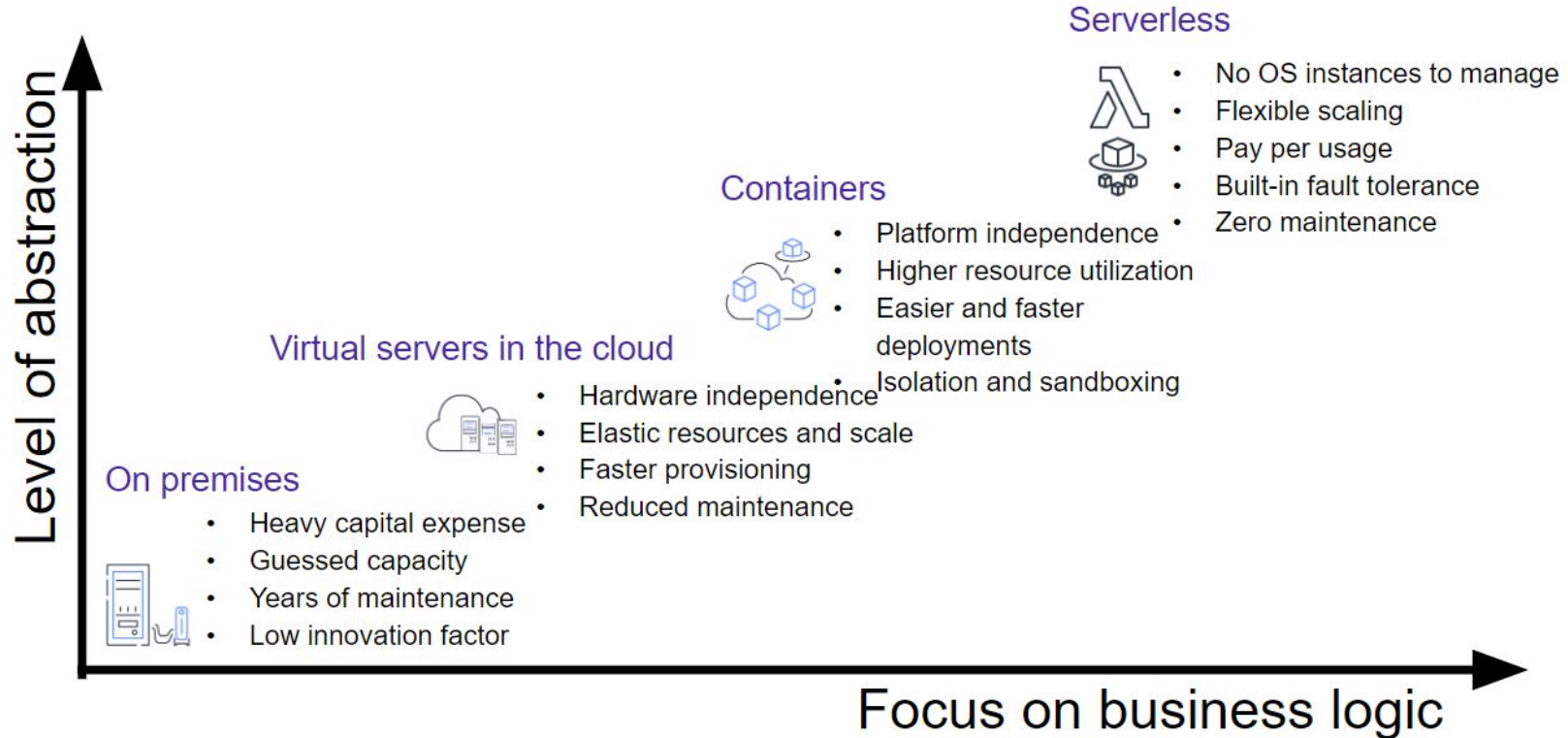


Scales with usage

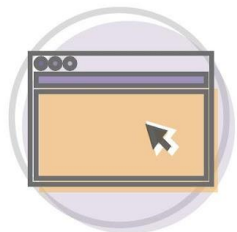


**Availability and fault
tolerance built in**

Evolving to serverless

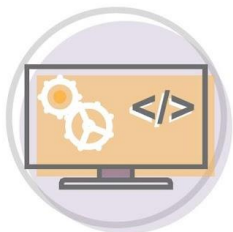


Common use cases for serverless applications



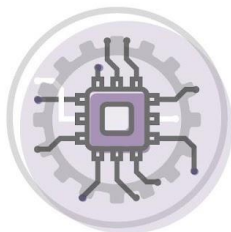
Web Applications

- Static websites
- Complex web apps
- Packages for Flask and Express



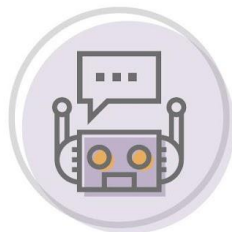
Backends

- Apps & services
- Mobile
- IoT



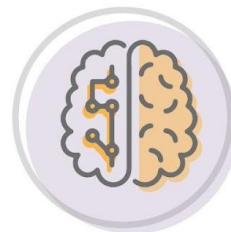
Data Processing

- Real time
- MapReduce
- Batch



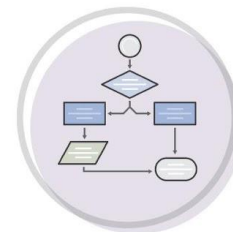
Chatbots

- Powering chatbot logic



Amazon Alexa

- Powering voice-enabled apps
- Alexa Skills Kit



Autonomous IT

- Policy engines
- Extending AWS services
- Infrastructure management

AWS Lambda

Lambda is a **serverless compute** service that you can use to **run code without provisioning** or managing servers & runtime environments.

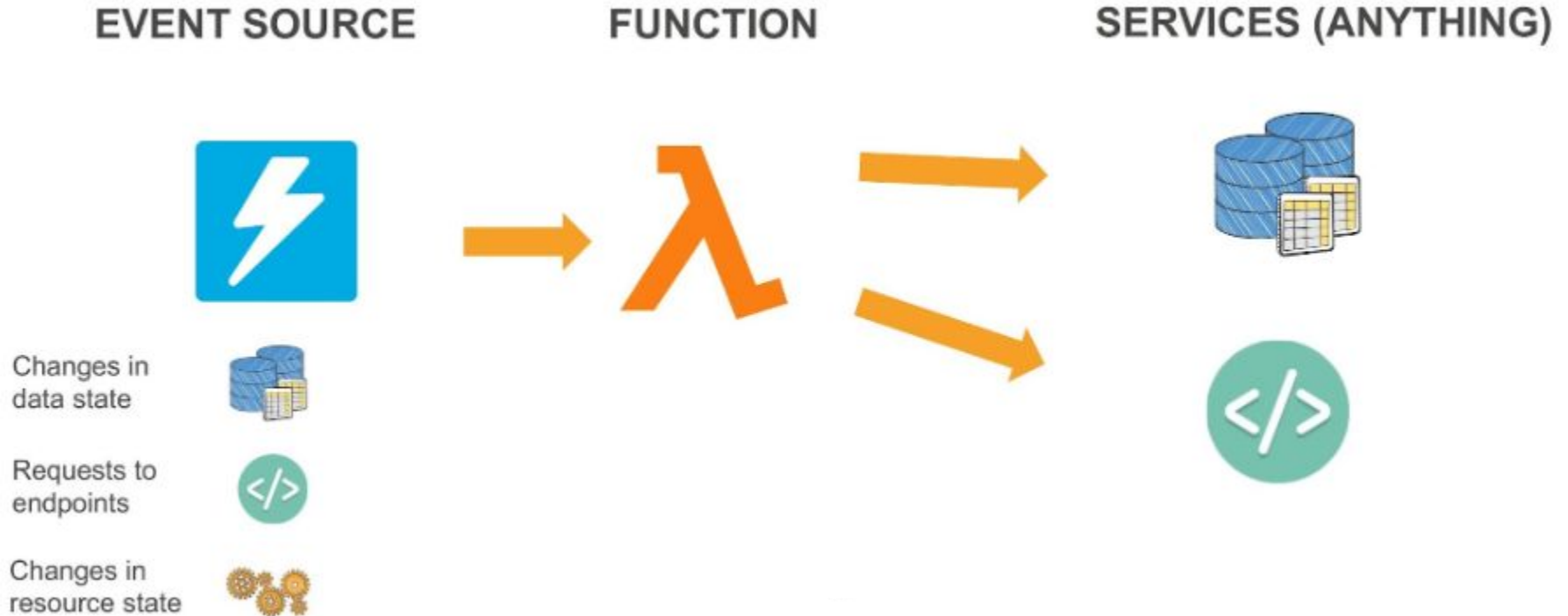
- **Invokes** your code in response to events
- **Scales** automatically
- Provides **built-in code monitoring** and **logging** with Amazon CloudWatch

AWS Lambda

AWS Lambda manages:

- Load balancing
- Autoscaling
- Availability
- Security isolation
- OS management
- ...

AWS Lambda



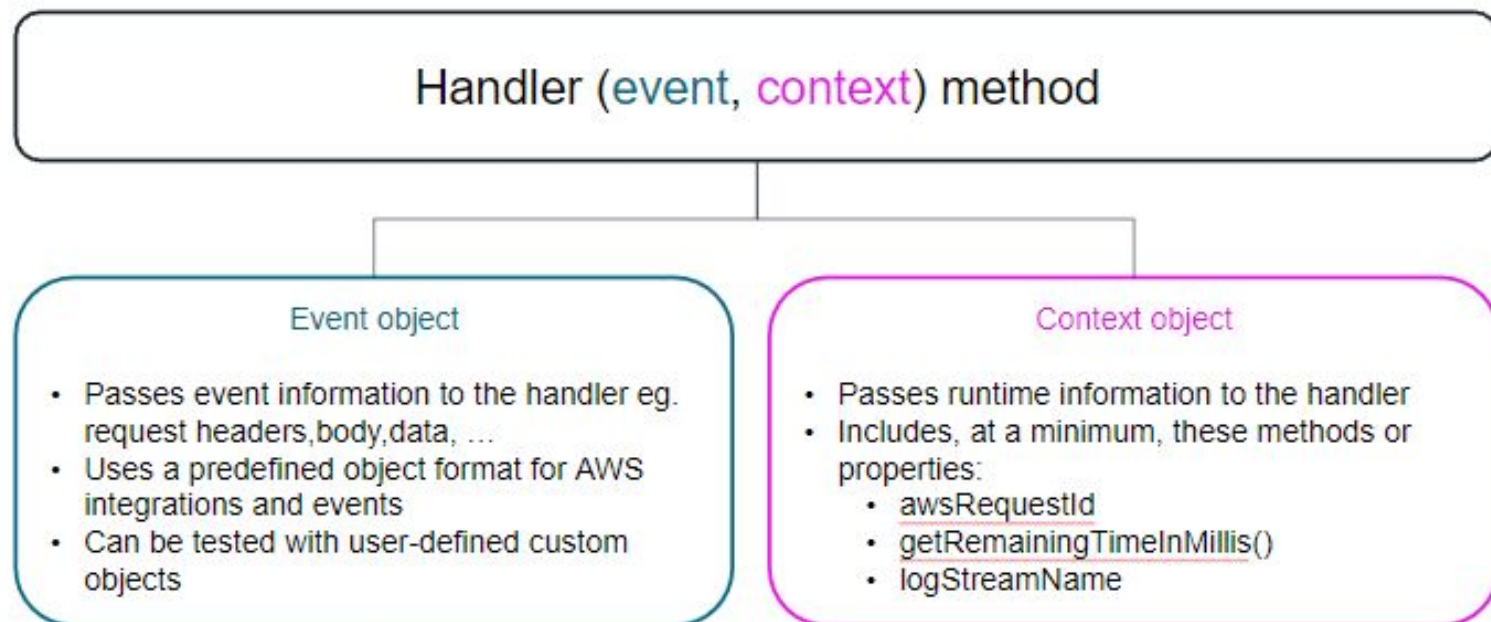
Lambda function handler

- Function in runtime of choice
- Receives a variable event and context
- Returns a object / value

```
Handler    def lambda_handler(event, context):  
            message = 'Hello {} {}!'.format(event['first_name'],  
                                             event['last_name'])  
            return {  
                'message' : message  
            }  
            response
```

A blue line originates from the closing curly brace of the return statement in the code block above. It extends downwards and then turns to the right, ending with an arrow pointing to the word 'response'.

Lambda function handler



Under the hood

- On demand containers with Isolated runtime environments
 - on EC2 instances in different AZs
 - sandboxed (see [firecracker](#))
- Stateless: No persistence
- Can automatically scale by running concurrent instances

Runtime [Info](#)

Choose the language to use to write

Node.js 18.x

Latest supported

.NET 6 (C#/PowerShell)

Go 1.x

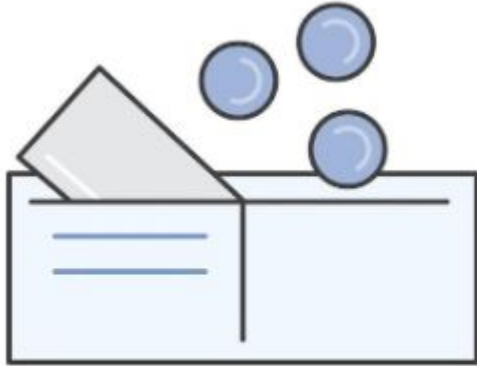
Java 11 (Corretto)

Node.js 18.x

Python 3.10

Ruby 2.7

Fine-grained pricing



Free Tier

1M requests and 400,000 GB-s of compute.
Every month, every customer.

Buy compute time in 100ms increments

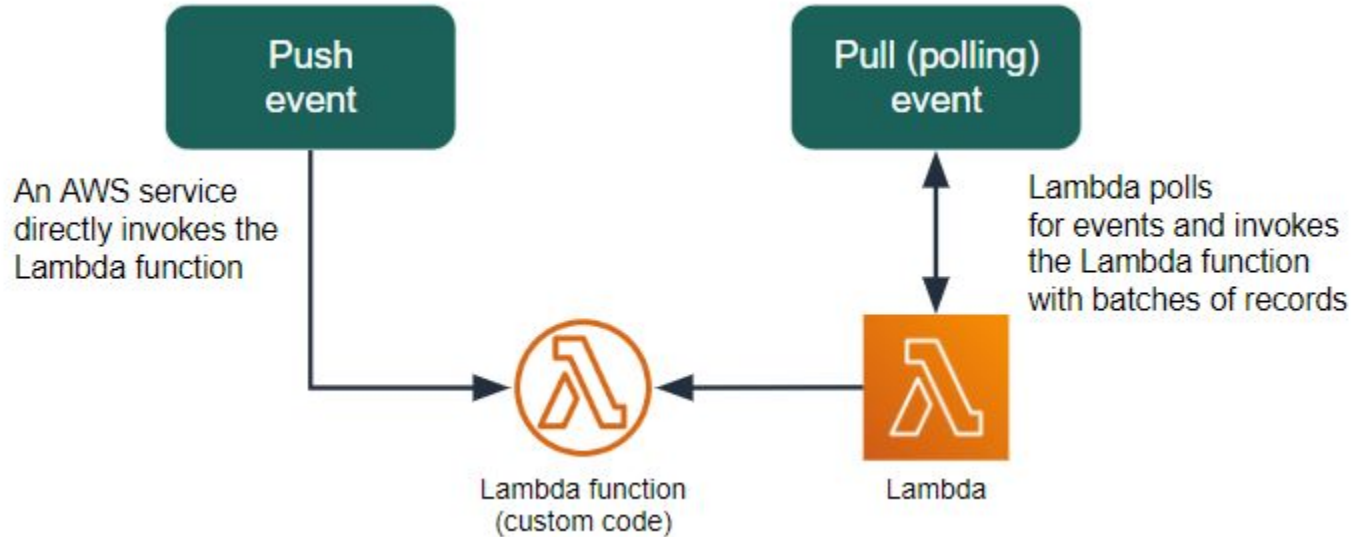
Low request charge

No hourly, daily, or monthly minimums

No per-device fees

Never pay for idle

Lambda execution model



Lambda execution model - Push

Synchronous

The other service waits for a response from your function.

No retry built in

Invoke via API:
RequestResponse
e



API
Gateway

/order



Lambda
function

Asynchronous

Lambda queues the event before passing it to your function.

0-2 retries

Invoke via API:
Event



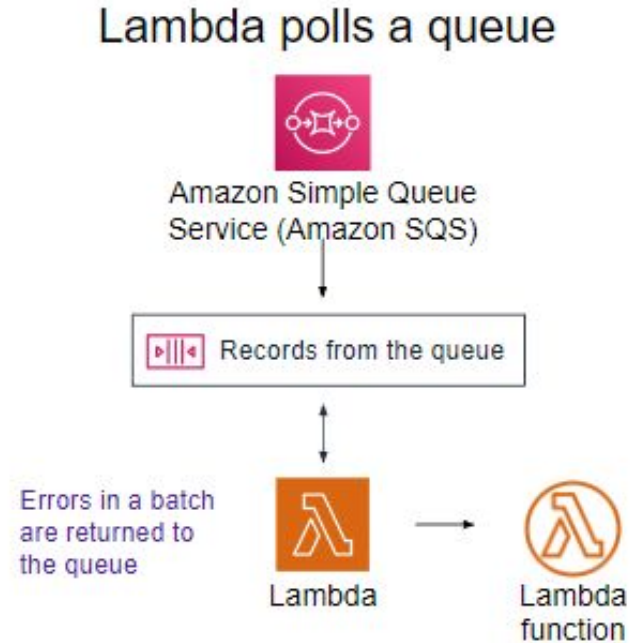
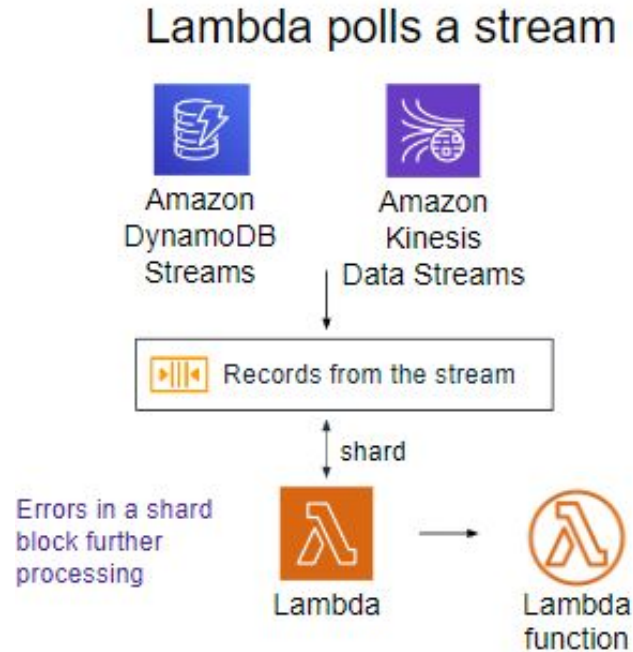
Amazon S3

3 tries

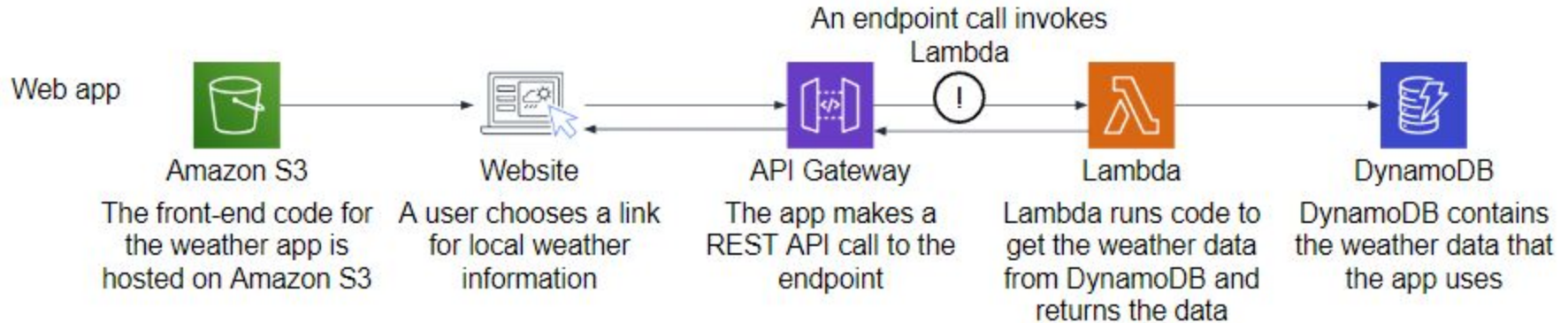


Lambda
function

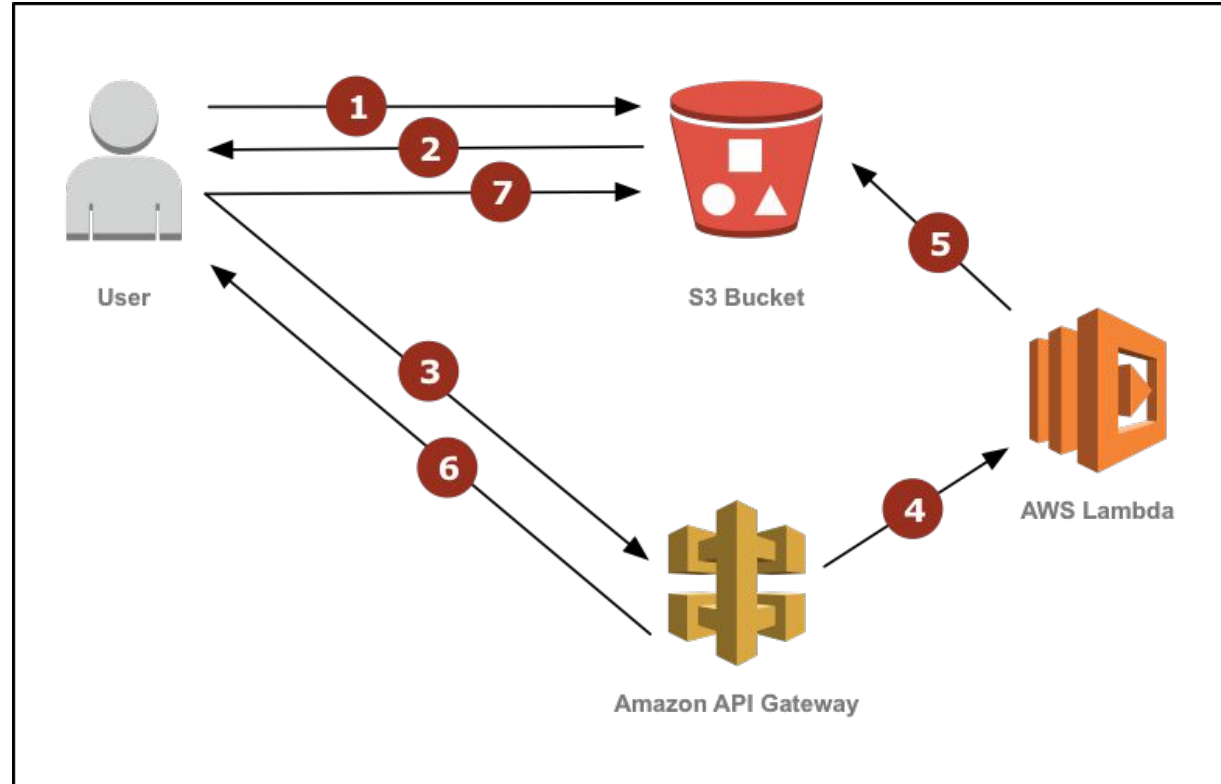
Lambda execution model - Polling



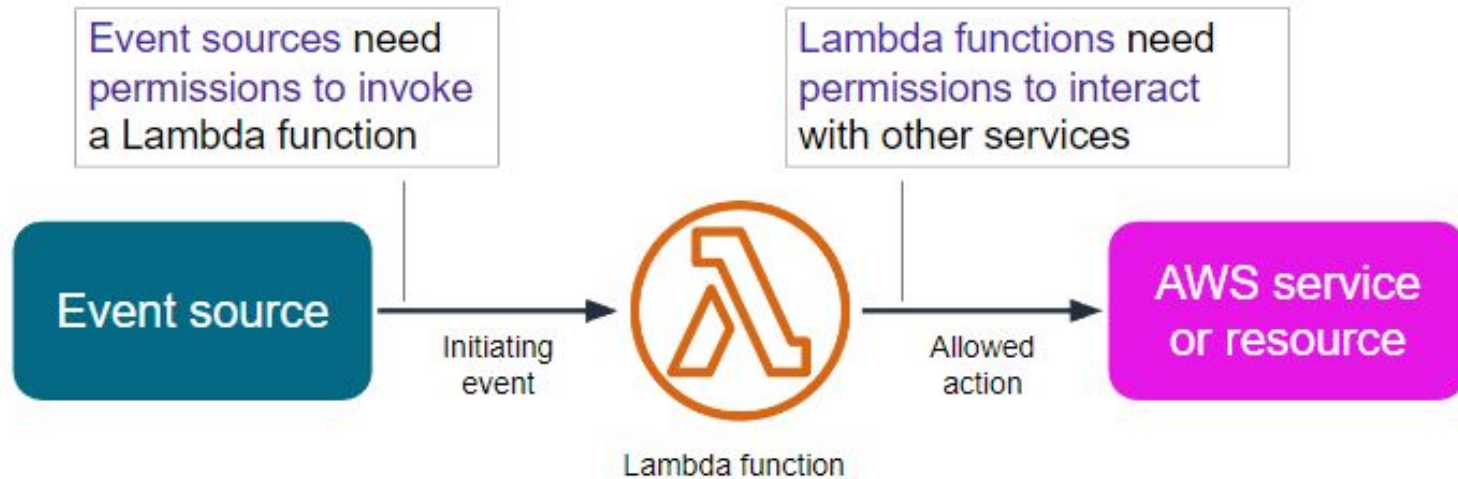
Practical example (1)



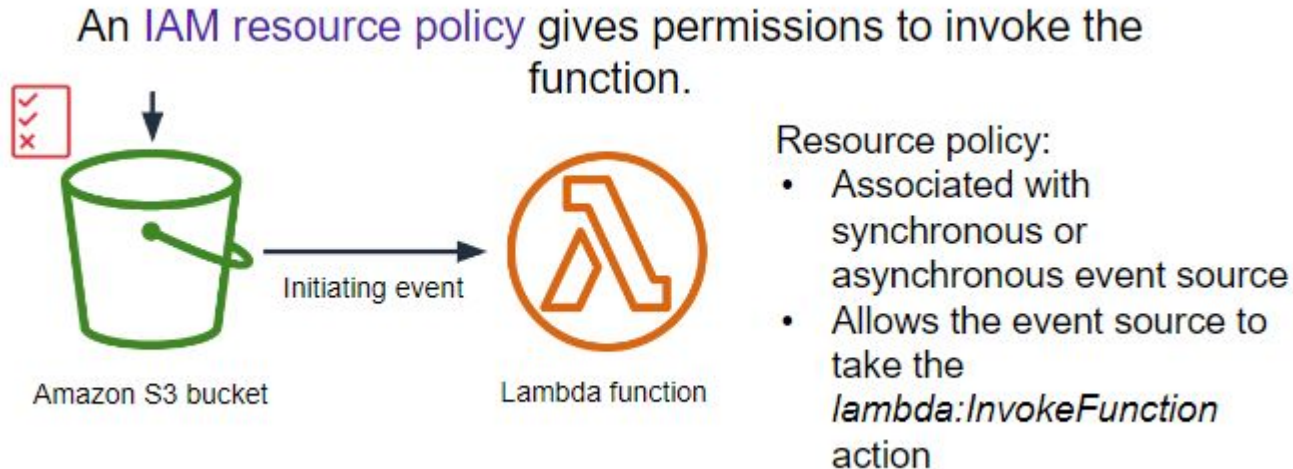
Practical example (2)



IAM resource policies



IAM resource policies



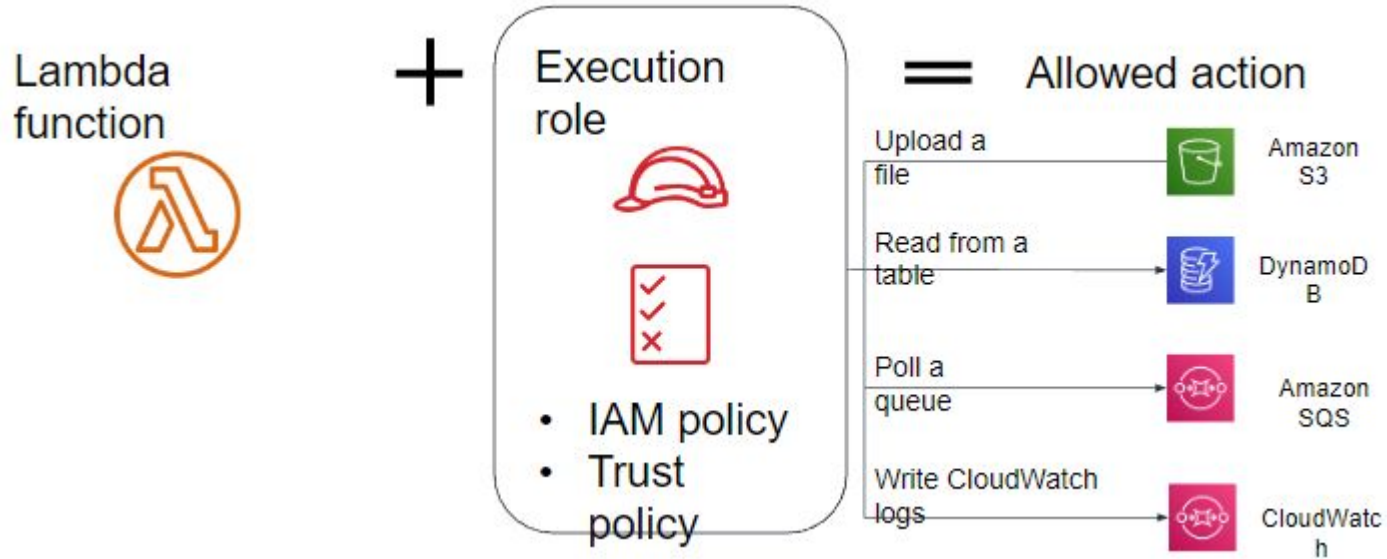
* We cannot create roles and resource policies in AWS academy. Use the existing LabRole!

IAM Resource policies

Allow an S3 bucket to trigger a Lambda function

```
{
  "Version": "2012-10-17",
  "Id": "default",
  "Statement": [
    {
      "Sid": "lambda-fd269e28-988b-4d2b-96ae-eabcd7dc399c",
      "Effect": "Allow",
      "Principal": {
        "Service": "s3.amazonaws.com"
      },
      "Action": "lambda:InvokeFunction",
      "Resource": "arn:aws:lambda:function:myFirstFunction",
      "Condition": {
        "ArnLike": {
          "AWS:SourceARN": "arn:aws:s3:::myBucket1"
        }
      }
    }
  ]
}
```

Lambda execution role



Debugging

- Testing from the AWS console using test events
 - can be saved, shared, copied, ...
- Provide instant feedback about results and logs

Test event action

☒ Create new event ☐ Edit saved event

Event name

my-test-event

Maximum of 25 characters consisting of letters, numbers, dots, hyphens and underscores.

Event sharing settings

☒ Private
This event is only available in the Lambda console and to the event creator. You can configure a t

☐ Shareable
This event is available to IAM users within the same account who have permissions to access and i

Template - optional

test-add-todo

Event JSON

```
1 {  
2   "httpMethod": "POST",  
3   "body": "{\"title\": \"test-item\", \"label\": \"test-label\", \"  
4 }
```

Debugging

Tools
Window
Test
Deploy

index.mjs
Execution result:

Status: **Succeeded**
Max memory used: 96 MB
Time: 1052.65 ms

Execution results

Test Event Name
test-add-todo

Response

```
{
  "statusCode": "200",
  "body": "{\"_id\":\"9b50f4bc-cc2d-4893-b2be-d2dc89e03f52\",\"title\":\"test-item\",\"label\":\"test-label\",\"completed\":false}\",
  "headers": {
    "Content-Type": "application/json",
    "Access-Control-Allow-Headers": "*",
    "Access-Control-Allow-Origin": "*",
    "Access-Control-Allow-Methods": "*"
  }
}
```

Function Logs

```
START RequestId: a1d11586-40a1-41a2-8292-338517861ccb Version: $LATEST
2023-04-21T06:25:26.981Z a1d11586-40a1-41a2-8292-338517861ccb INFO Received event: {
  "httpMethod": "POST",
  "body": "{\"title\":\"test-item\", \"label\":\"test-label\", \"completed\": false}"
}
END RequestId: a1d11586-40a1-41a2-8292-338517861ccb
REPORT RequestId: a1d11586-40a1-41a2-8292-338517861ccb Duration: 1052.65 ms Billed Duration: 1053 ms Memory Size: 128 MB Max
```

Request ID
a1d11586-40a1-41a2-8292-338517861ccb

Debugging

- Lambda logs all requests handled by your function
- automatically stores logs generated by your code through Amazon CloudWatch Logs.

CloudWatch > Log groups > /aws/lambda/addTodo > 2023/04/21/[\$LATEST]ba80419bd95f453c810de863b7ed9353

Log events

You can use the filter bar below to search for and match terms, phrases, or values in your log event

▶	Timestamp	Message
		No more records within selected time range Retrying...
▶	2023-04-21T08:25:26.353+02:00	INIT_START Runtime Version: nodejs:18.v5 Runtime...
▶	2023-04-21T08:25:26.979+02:00	START RequestId: a1d11586-40a1-41a2-8292-338517861ccb
▶	2023-04-21T08:25:26.981Z	2023-04-21T08:25:26.981Z a1d11586-40a1-41a2-8292-338517861ccb
▶	2023-04-21T08:25:28.034+02:00	END RequestId: a1d11586-40a1-41a2-8292-338517861ccb
▶	2023-04-21T08:25:28.034+02:00	REPORT RequestId: a1d11586-40a1-41a2-8292-338517861ccb
		No more records within selected time range Auto...

1h 3h 12h 1d 3d 1w Custom (4w)

Recent invocations

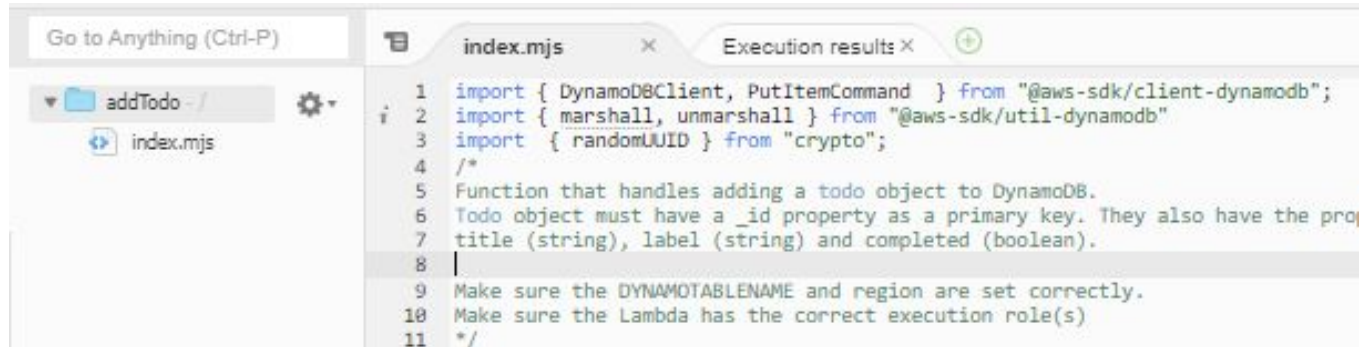
#	Timestamp	RequestID	LogStream	DurationInMS	BilledDurationInMS	
▶ 1	2023-04-21T06:25:28.034Z	a1d11586-40a1-41a2-8292-338517861ccb	2023/04/21/[\$LATEST]ba80419bd95f453c810de863b7ed9353	1052.65	1053.0	:
▶ 2	2023-04-18T14:34:30.641Z	2a23617f-d82a-4bfb-bfbe-9047eff0b5ce	2023/04/18/[\$LATEST]3ab8a3404bf74d19b430dd9dedb8e06a	1054.22	1055.0	:
▶ 3	2023-04-18T14:17:23.105Z	855e0198-0708-4935-b371-013f252115e2	2023/04/18/[\$LATEST]025617d080e84d538206fb98afaed7ef	512.2	513.0	:
▶ 4	2023-04-18T14:17:10.405Z	3c658fc1-18e9-4c46-9a23-9f4af2ab24fb	2023/04/18/[\$LATEST]025617d080e84d538206fb98afaed7ef	680.38	681.0	:
▶ 5	2023-04-18T14:13:23.003Z	7ecb13ee-6601-4837-8e29-90e383026249	2023/04/18/[\$LATEST]025617d080e84d538206fb98afaed7ef	1075.18	1076.0	:
▶ 6	2023-04-11T12:03:20.579Z	2bd4bf7c-5593-4a03-9a51-6a537f49344c	2023/04/11/[\$LATEST]93c96afe1aac4052af3c4a7c06a0db09	593.5	594.0	:

Packaging

- ZIP files: Packages your code and any dependencies into a single ZIP file
 - Create a ZIP file of your code and any dependencies
 - Upload the ZIP file to Lambda directly in the lambda interface or link them from an S3 bucket
- Container images: Packages your code and any dependencies into a Docker container image
 - Build a docker image and push it to a container registry such as Amazon ECR
 - Specify the image URI when creating your Lambda function
- Build tools such as AWS SAM / Serverless framework help you automate this process

Packaging - 3rd party modules

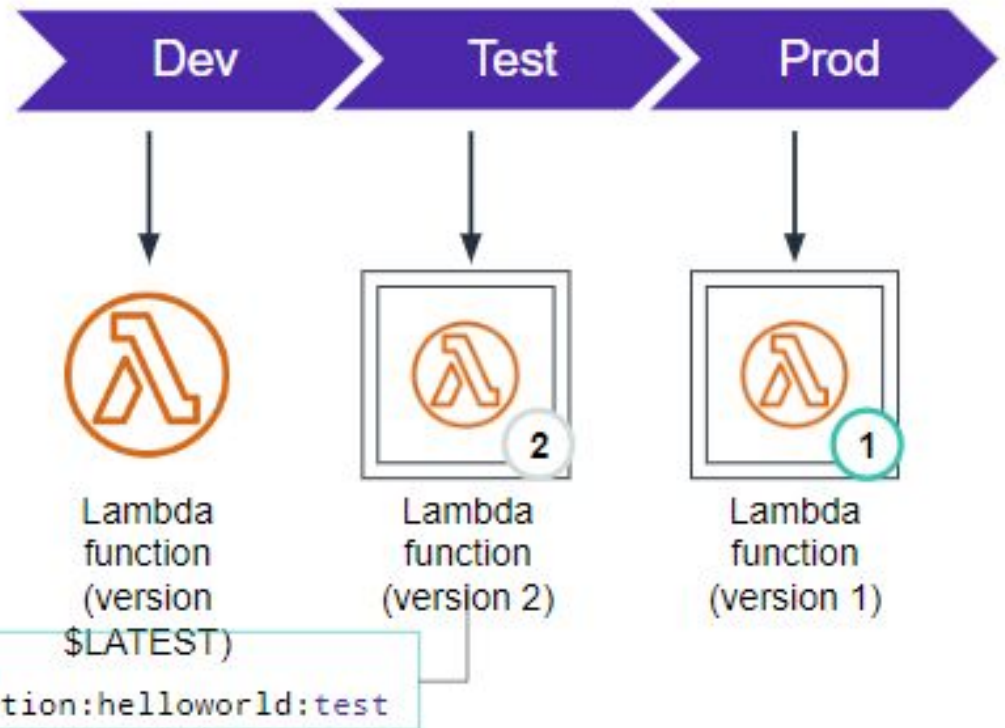
- Third-party modules can be easily integrated into your Lambda function
 - eg. Using package.json and node_modules for NodeJS
- Some dependencies are installed by default, for example all AWS-SDK dependencies:



```
1 import { DynamoDBClient, PutItemCommand } from "@aws-sdk/client-dynamodb";
2 import { marshal, unmarshal } from "@aws-sdk/util-dynamodb";
3 import { randomUUID } from "crypto";
4 /*
5  Function that handles adding a todo object to DynamoDB.
6  Todo object must have a _id property as a primary key. They also have the prop
7  title (string), label (string) and completed (boolean).
8  |
9  Make sure the DYNAMOTABLENAME and region are set correctly.
10 Make sure the Lambda has the correct execution role(s)
11 */
```

Deployment & versioning

- Mutable pointers to versions
- Each alias has its own ARN



AWS Lambda limits

Resource Limits	Default Limit
Ephemeral disk capacity ("/tmp" space)	512 MB
Number of file descriptors	1024
Number of processes and threads (combined total)	1024
Maximum execution duration per request	300 seconds
Invoke request body payload size (RequestResponse)	6 MB
Invoke request body payload size (Event)	128 K
Invoke response body payload size (RequestResponse)	6 MB
Dead-letter payload size (Event)	128 K
Deployment Limits	Default Limit
Lambda function deployment package size (.zip/.jar file)	50 MB
Size of code/dependencies that you can zip into a deployment package (uncompressed zip/jar size)	250 MB
Total size of all the deployment packages that can be uploaded per region	75 GB
Total size of environment variables set	4 KB
Throttling Limits (can request service limit increase)	Default Limit
Concurrent executions	1000



Lambda labs



- Online lab platform
 - AWSGen (Lambda)
 - Deploy and secure an API using lambda and API gateway
 - Secure an API using API gateway

