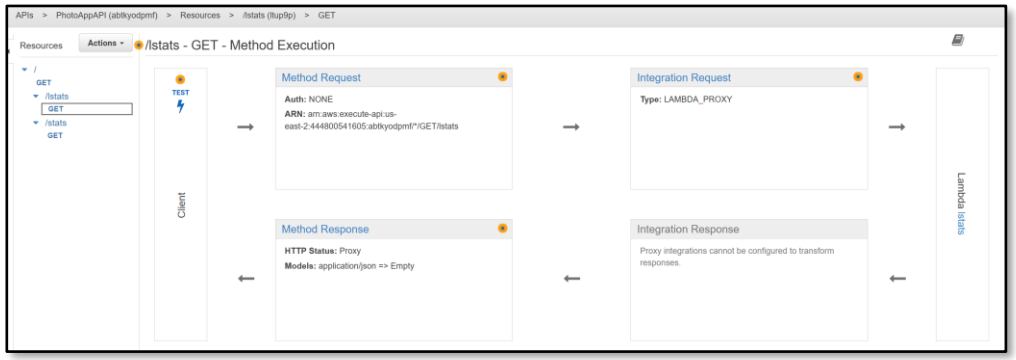
API Gateway

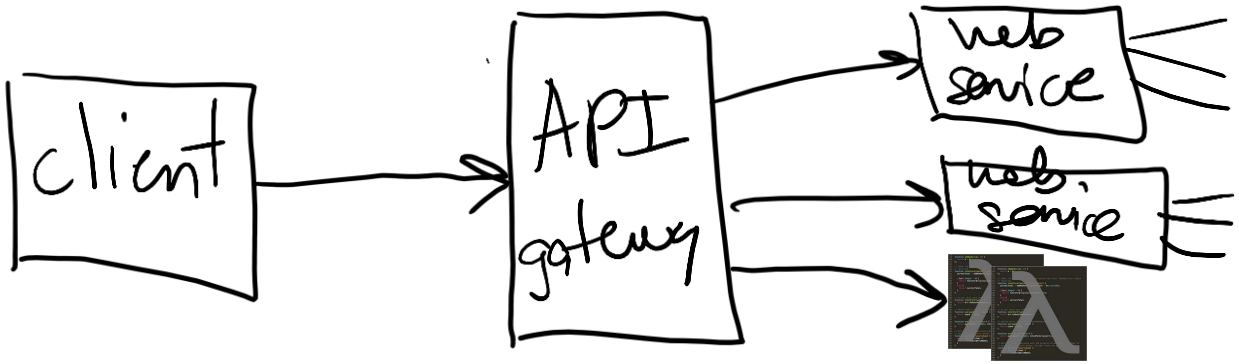
- **Programming example**
  - **API Gateway + lambda**

- **Other ways to call lambda functions**

API Gateway

- **API Gateway allows you to define a RESTful API that forwards to other services / lambdas**
  - *Define HTTP verb and URL path (e.g. GET /movies)*
  - *Specify target…*





Programming demo

- **Let's build a simple calculator using API Gateway and lambda…**

(1) lambda functions

```
#
# uuid()
#
import json
import uuid

def lambda_handler(event, context):
  result = str(uuid.uuid4())

  print("uuid:", result)

  return {
    'statusCode': 200,
    'body': json.dumps(result)
  }
```

```
#
# pow(x, e)
#
import json

def lambda_handler(event, context):
  params = event["pathParameters"]
  x = float(params["x"])
  e = float(params["e"])

  result = x ** e

  print("pow:", x, e, result)

  return {
    'statusCode': 200,
    'body': json.dumps(result)
  }
```

```
#
# factors(n)
#
import json

def lambda_handler(event, context):
  params = event["queryStringParameters"]
  n = int(params["n"])

  i = 2
  factors = []
  while i * i <= n:
    if n % i:
      i += 1
    else:
      n //= i
      factors.append(i)

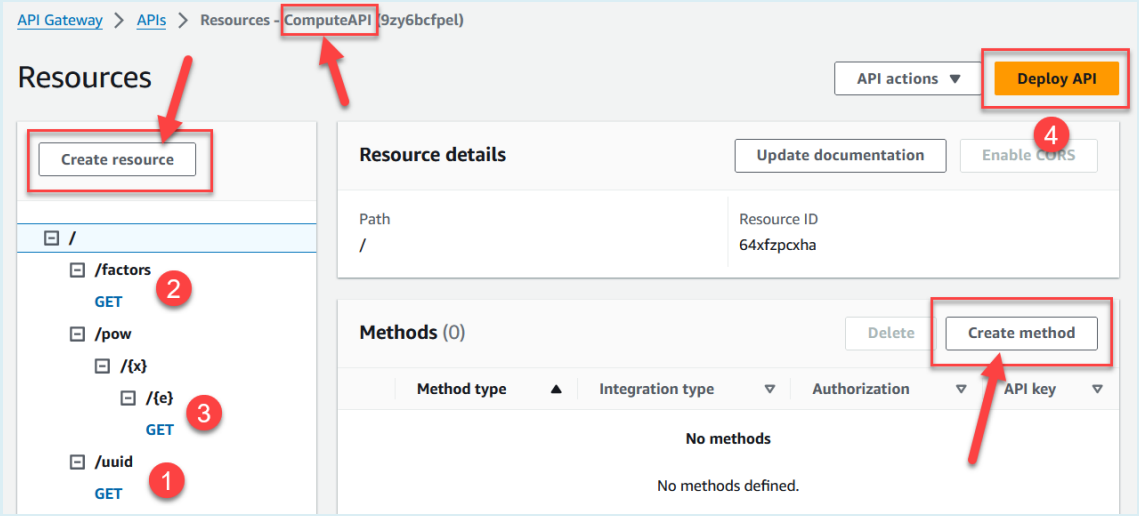
  if n > 1:
    factors.append(n)

  print("factors:", n, factors)

  return {
    'statusCode': 200,
    'body': json.dumps(factors)
  }
```

(2) Build API

- **In AWS, search for API Gateway service**

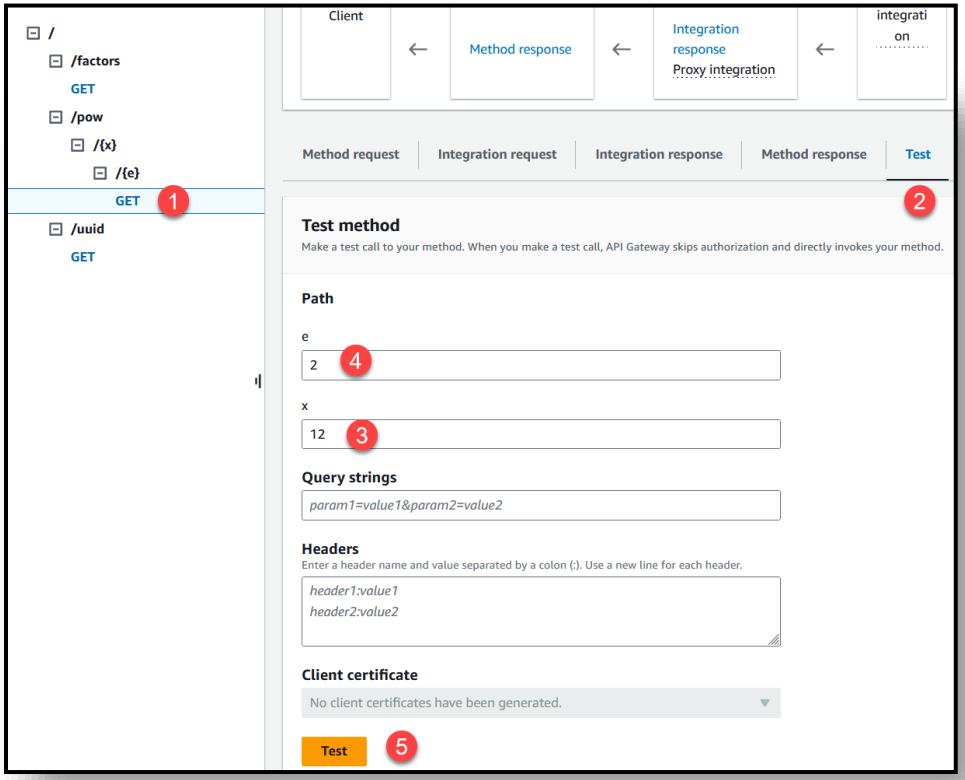


- **Create API**
  - *Select:* ***REST API***
  - *Name:* ***ComputeAPI***
  - *Create resources and method as shown (steps 1-3)*
  - *When you create methods:*
    - Lambda function
    - Enable Lambda proxy integration
    - Select function

When you're done, click "Deploy" and stage if you want (e.g. test)

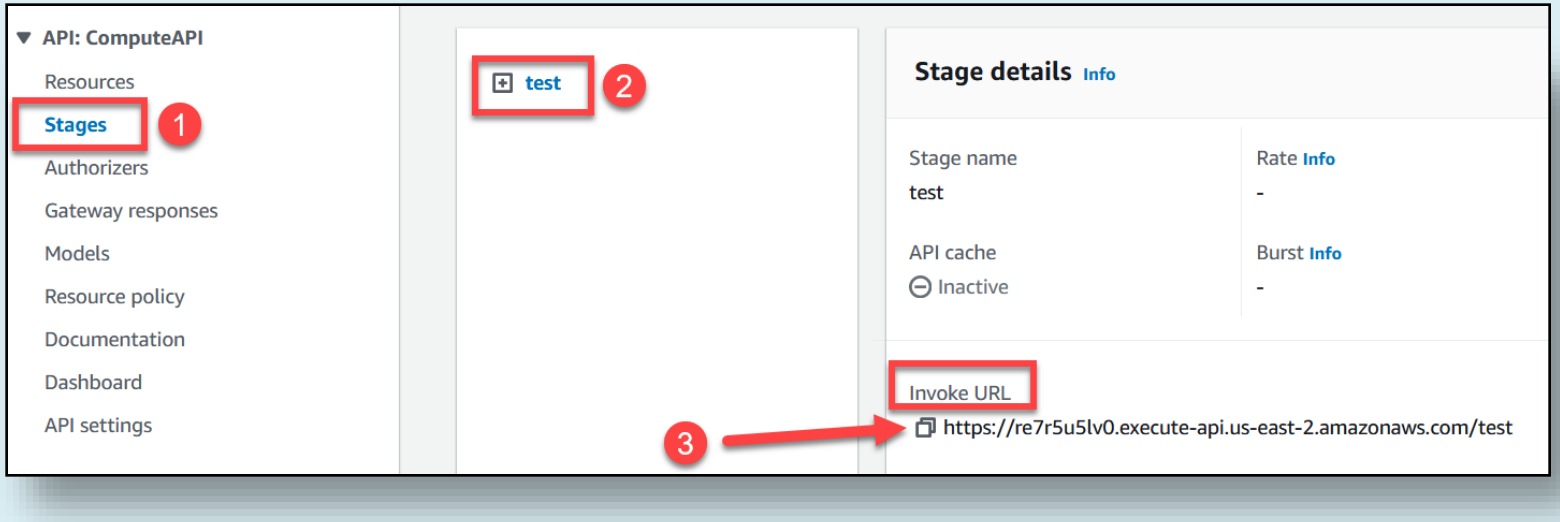
(3) Test API

- **Use the Test tab to test each function…**
  1. *uuid( ) has no parameters*
  2. *factors(n) has a query parameter, e.g. ?n=33*
  3. *pow(x, e) has path parameters, e.g. /pow/12/2*



(4) Deploy and copy API endpoint

- Click "Deploy API"
- Stages --- none, or e.g. "test" or "prod" (production)
- Click "Deploy"
- View stage, copy "Invoke URL"



(5) client-side testing

- **Since all the methods are GET, use web browser**
  - *API Gateway Endpoint/uuid*
  - *API Gateway Endpoint/factors?n=33*
  - *API Gateway Endpoint/pow/2/16*

- **Alternatively:**
  - *postman.com*
  - *HTTP requests from client app*

Python-based client-side app


```
import requests

baseurl = 'API Gateway Endpoint'

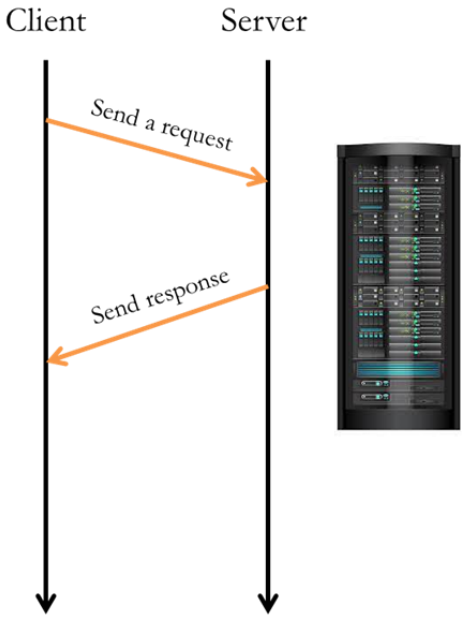
x = input('Enter base x> ')
e = input('Enter exponent e> ')

# build URL:
url = baseurl + '/pow/' + x + '/' + e

# call the web service:
response = requests.get(url)

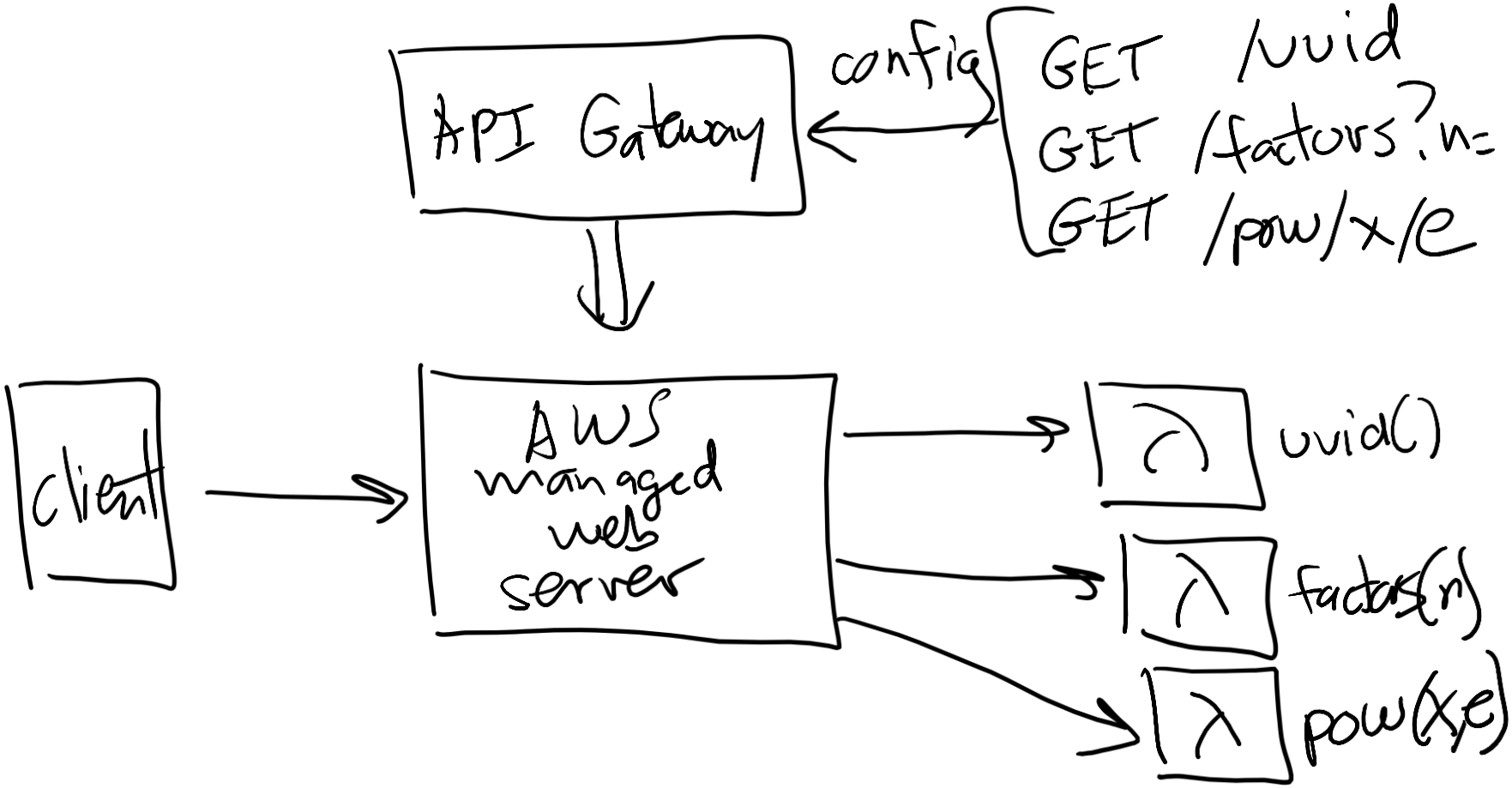
# output the result:
body = response.json()

print('status code:', response.status_code)
print('result x^e:', body)
```



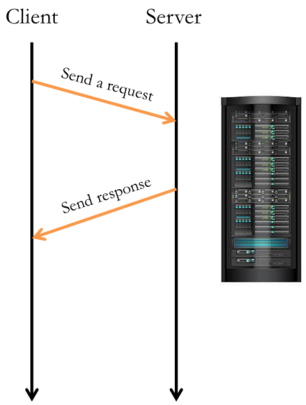
Summary

- **We have a serverless solution to running computations in the cloud**



Recall what we did earlier…

- **We did a similar web service using JS and node.js**




```
const express = require('express');
const app = express();

// main():
app.listen(3000, () => {
  console.log('**SERVER: web service running, listening on port 3000...');
});

// requests for default page /:
app.get('/', (req, res) => {
  console.log('**SERVER: call to /');
  res.send('<HTML><body>Home page is empty, we are a calculator service!</body></HTML>');
});

// API functions:
// raise x to the exponent e:
app.get('/pow/:x/:e', (req, res) => {…});
.
.
.
```

AWS lambda

- **By far the simplest, least expensive way to compute**

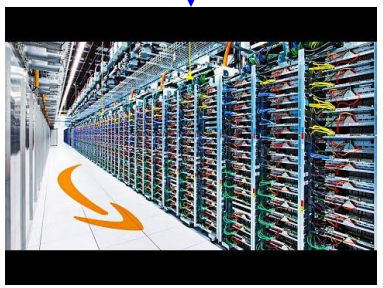
EC2, EKS, ECS, Fargate

Elastic Beanstalk

API Gateway + Lambda

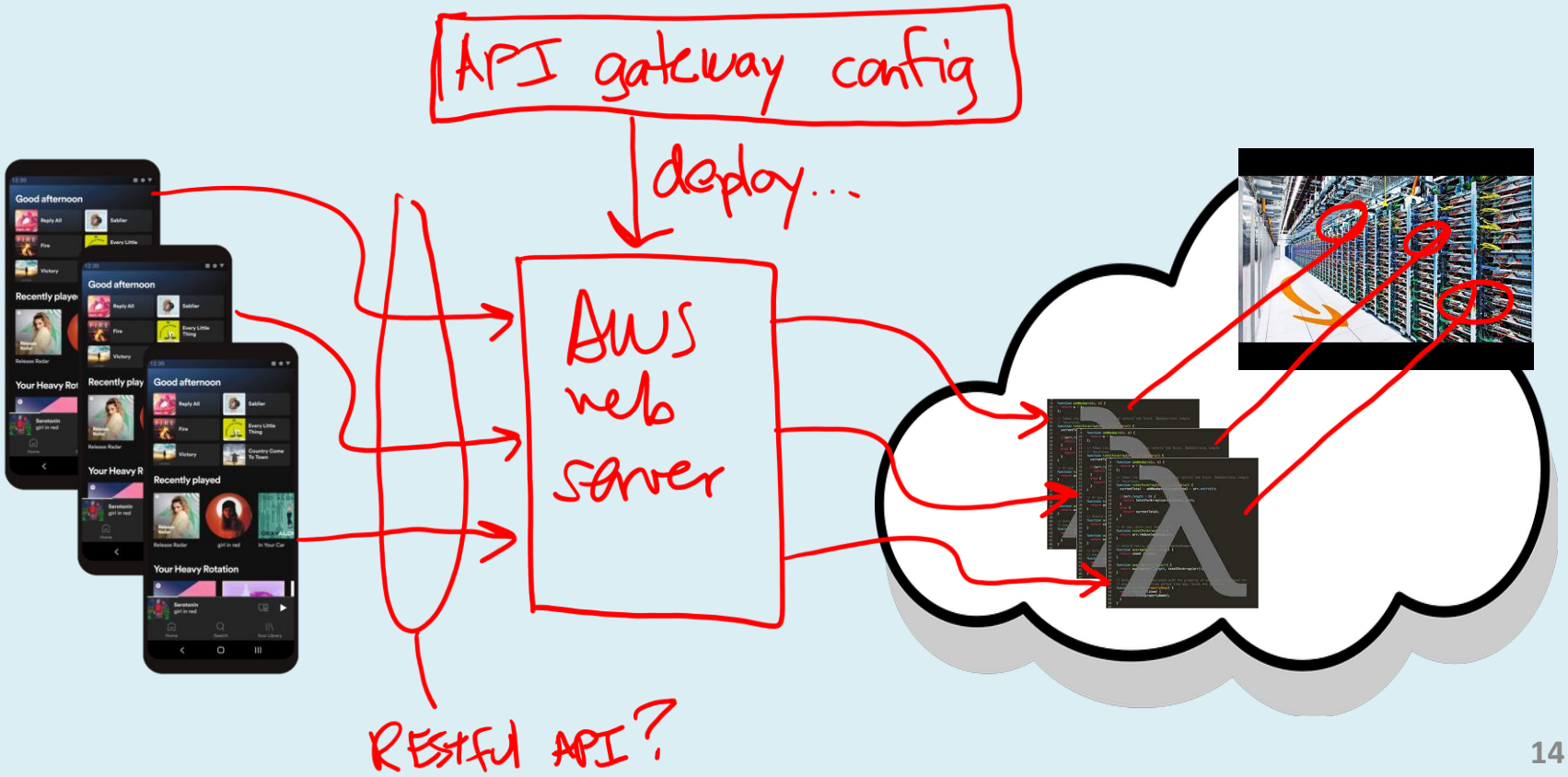
Lambda

function



Calling lambda functions

- **We used API Gateway to "call" our lambda functions**
  - *All the benefits of a traditional multi-tier design*
  - *Offers the most customization / config options*



(1) Calling lambda via function URL

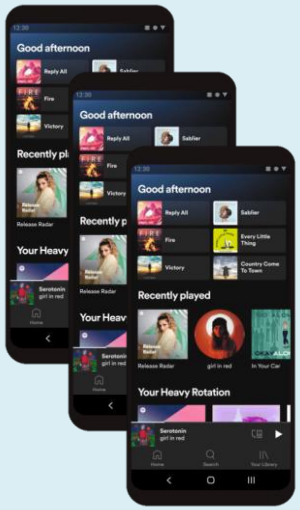
- **Multi-tier through AWS-managed web server**

Multi-tier design with the usual advantages. Good for simpler apps with a small API (not too many URLs)

Cannot map to non-lambda services to improve latency; limited configuration options (e.g. cannot support real-time WebSocket apps)

(2) Calling lambda directly from client

- **You can use AWS libraries (e.g. boto3) to call lambda functions directly…**



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```

Great for small projects and prototypes…

Requires config / credentials on the client; standard installation concerns; less secure?

That's it, thank you!