Build Cloud Infrastructure using Python

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The Emerging Tech Show

Agenda

- Infrastructure as/is code
- What is AWS Cloud Development Kit (CDK)?
- How it works
- Getting started
- Demo

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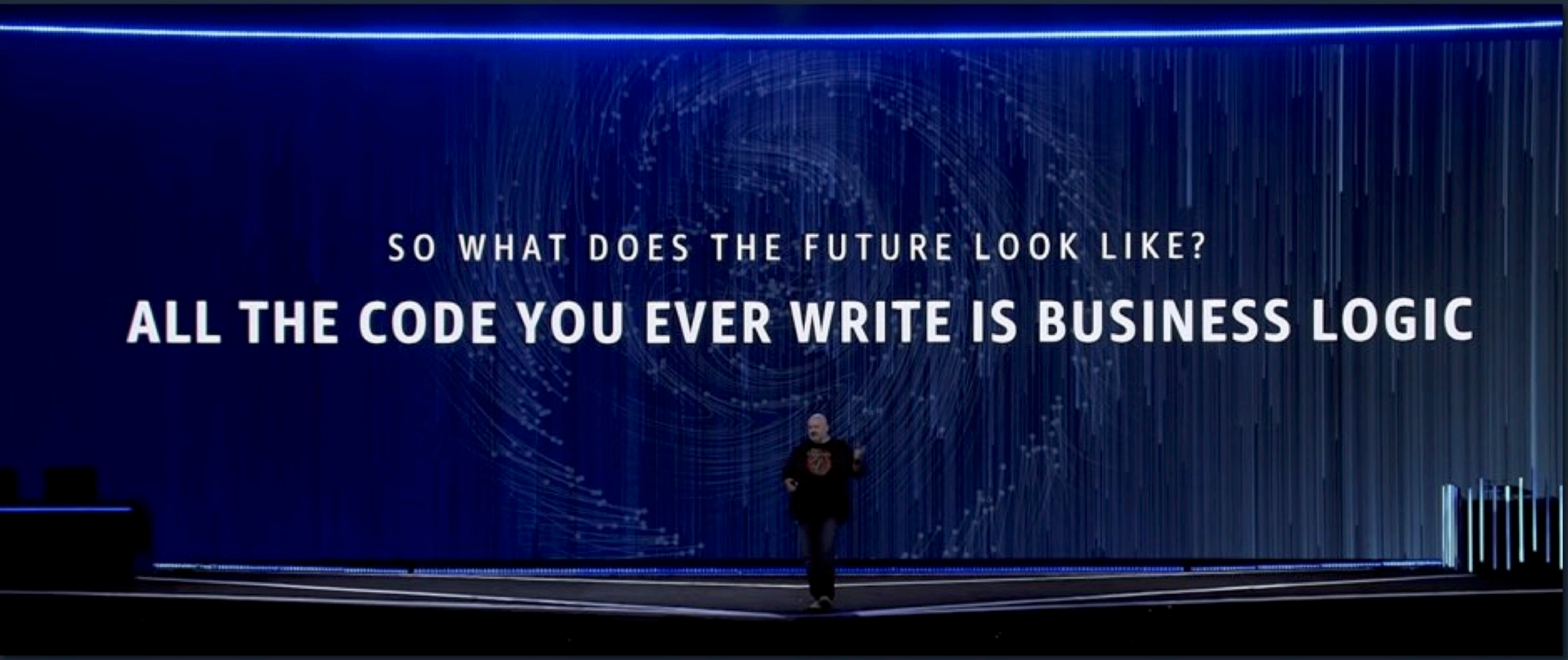

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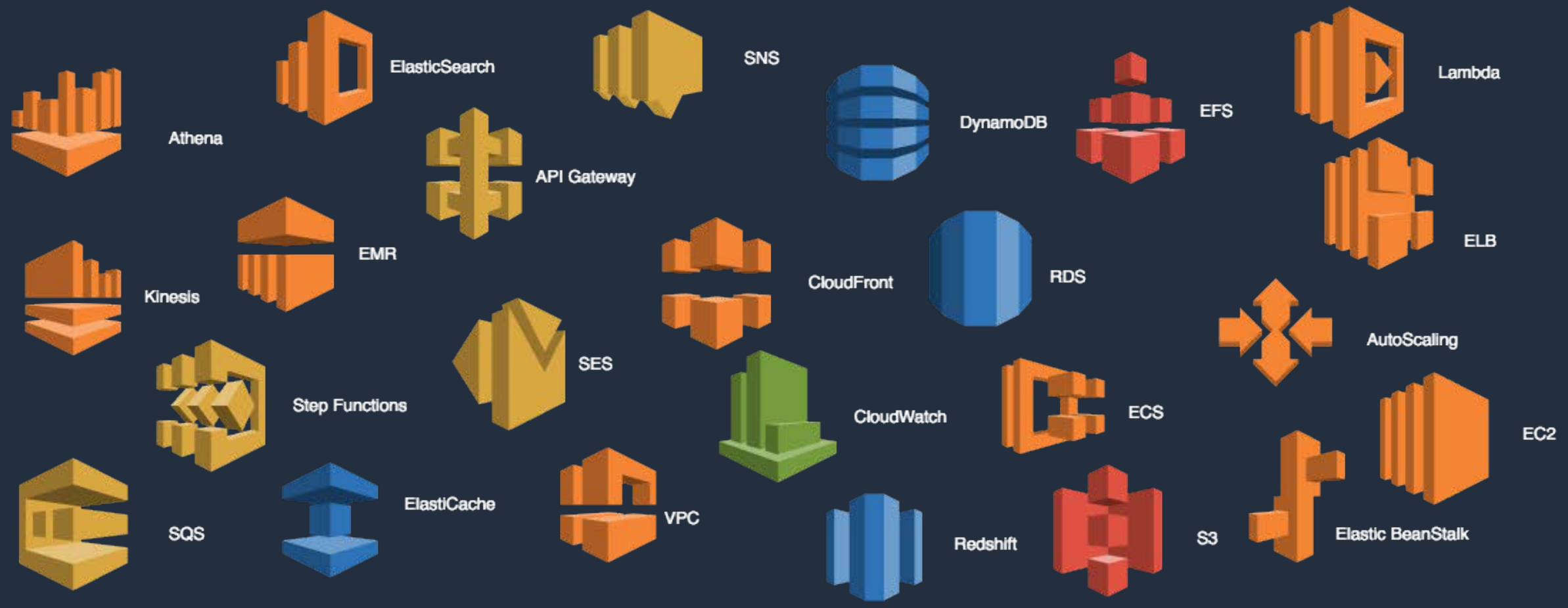
Modern cloud applications have lots of “bits”



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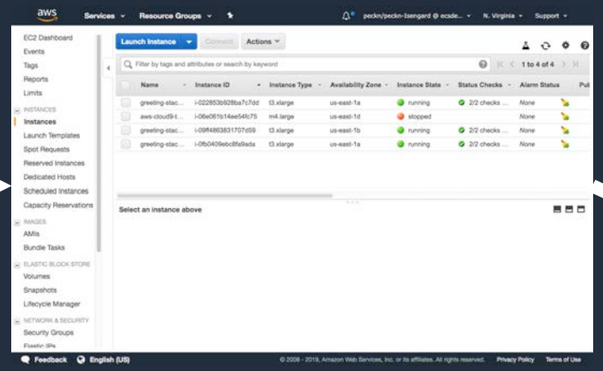
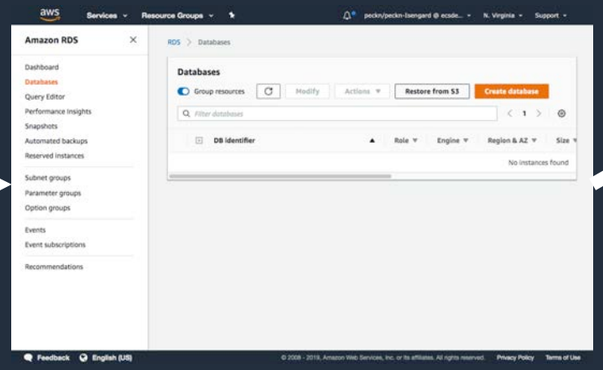
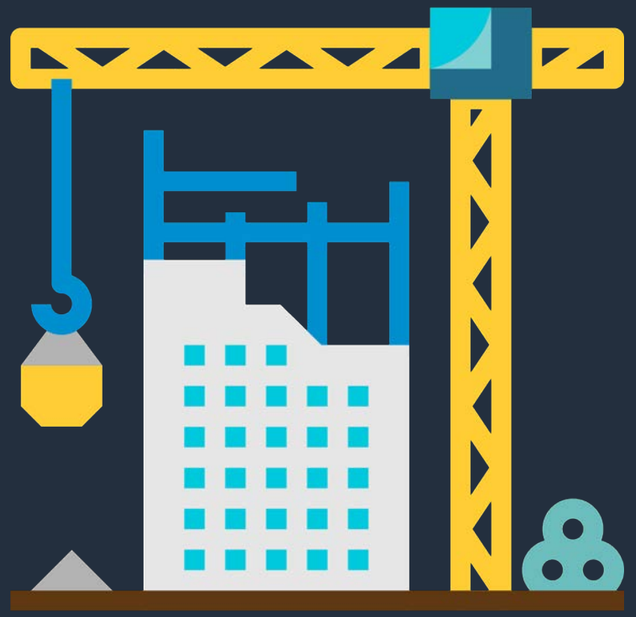
Introduction to Infrastructure as Code

Level 0: Creating infrastructure by hand







Your organization's infrastructure

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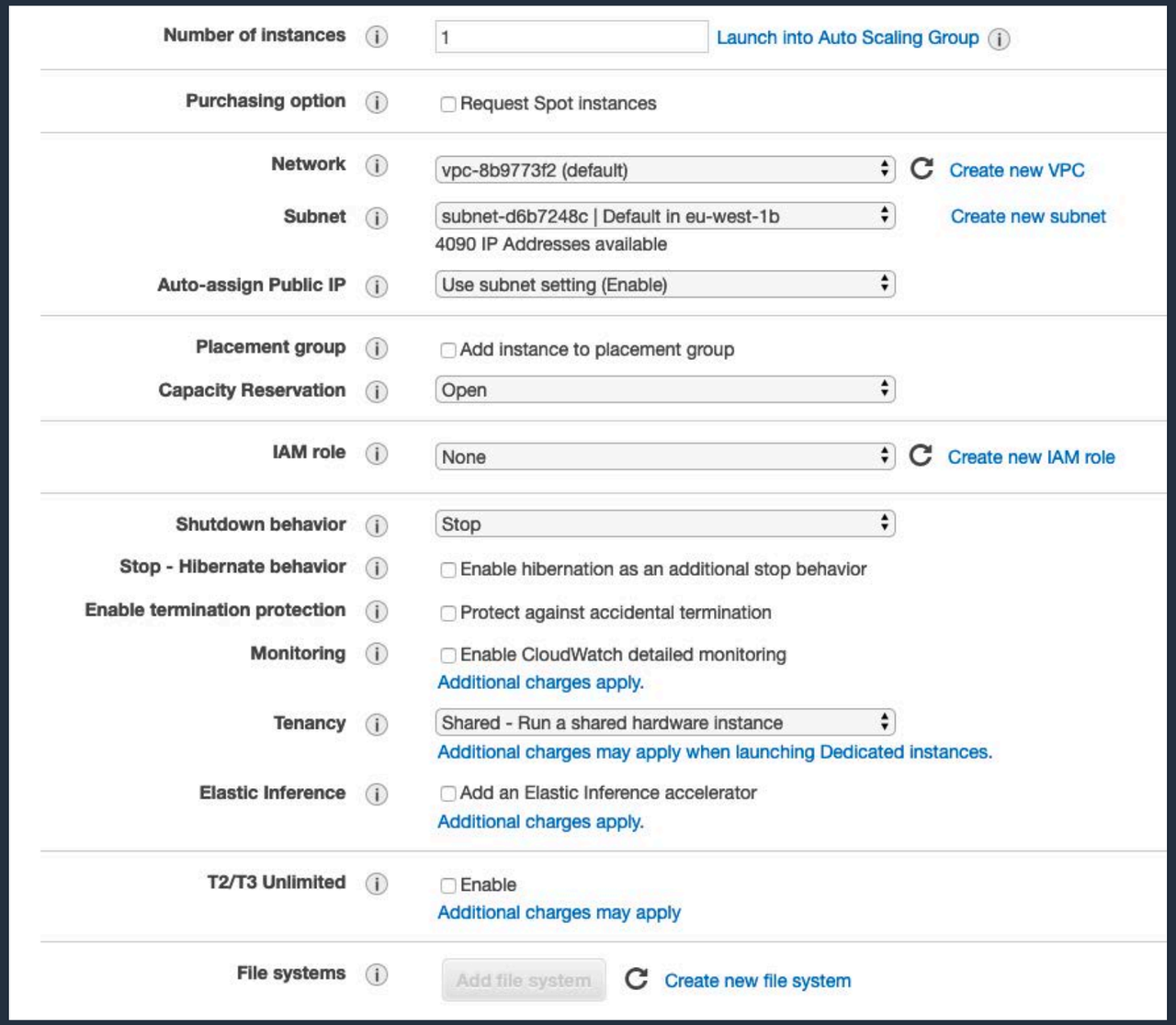
Use the AWS Console?



- 😩 Manual
- 😩 Time consuming
- 😩 Hard to audit
- 😩 Error prone
- 😩 Not reproducible

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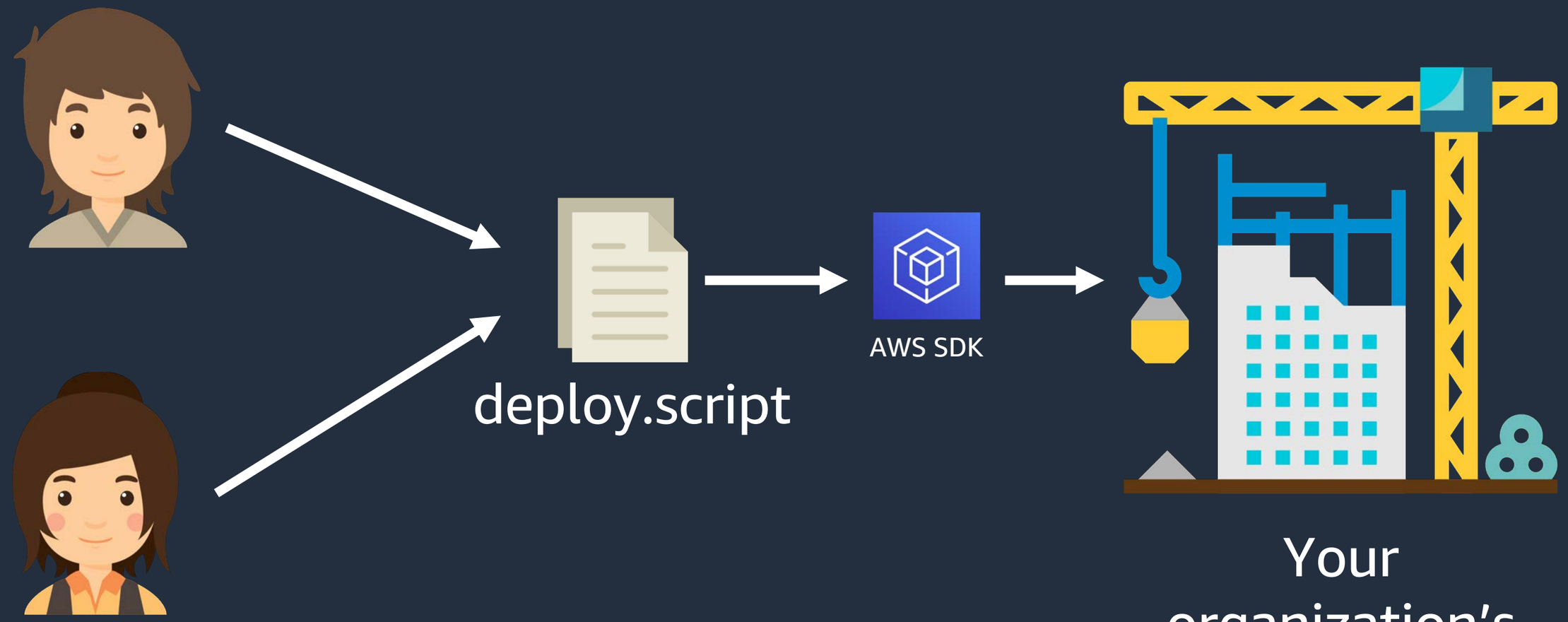
Level 1: Imperative infrastructure as code



Your organization's infrastructure

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Level 1: Imperative infrastructure as code

deploy.script

```
resource = getResource(xyz)

if (resource == desiredResource) {
  return
} else if (!resource) {
  createResource(desiredResource)
} else {
  updateResource(desiredResource)
}
```

- Lots of boilerplate
- What if something fails and we need to retry?
- What if two people try to run the script at once?
- Race conditions?

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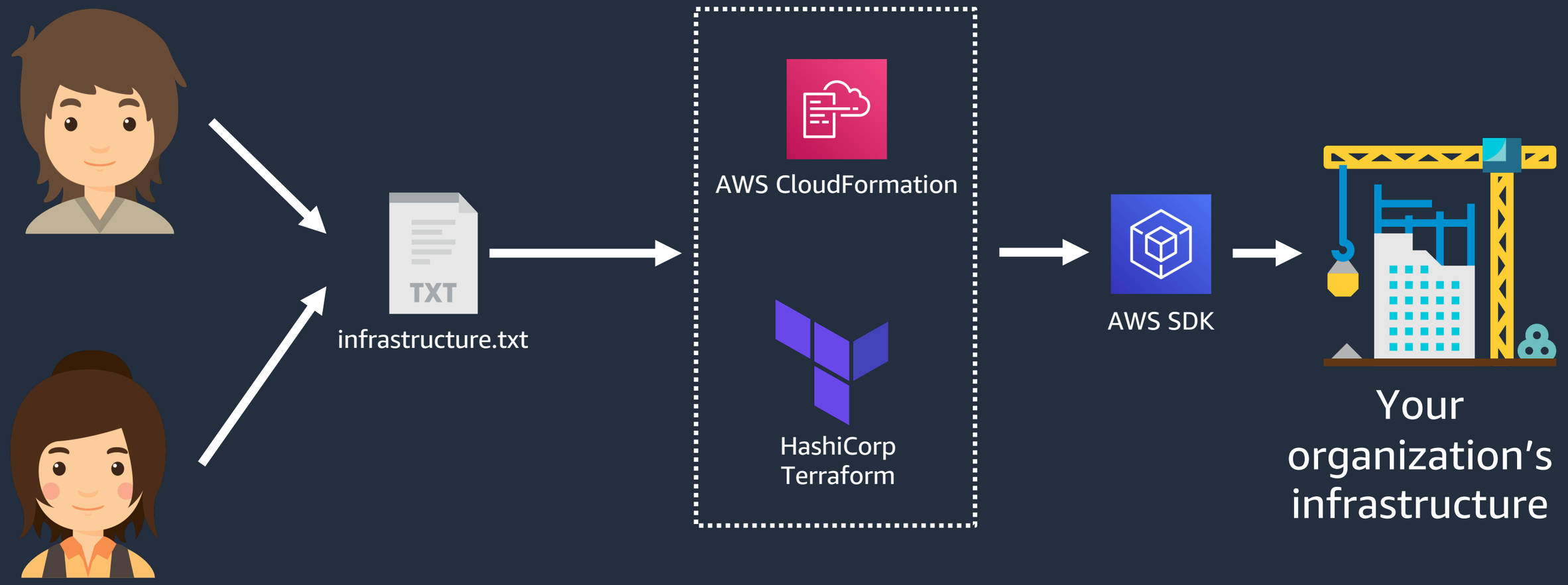
Level 2: Declarative Infrastructure as code



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Infrastructure as code

infrastructure.txt

```yaml
Resources:
  # VPC in which containers will be networked.
  # It has two public subnets
  # We distribute the subnets across the first two available subnets
  # for the region, for high availability.
  VPC:
    Type: AWS::EC2::VPC
    Properties:
      EnableDnsSupport: true
      EnableDnsHostnames: true
      CidrBlock: !FindInMap ['SubnetConfig', 'VPC', 'CIDR']

  # Two public subnets, where containers can have public IP addresses
  PublicSubnetOne:
    Type: AWS::EC2::Subnet
    Properties:
      AvailabilityZone:
         Fn::Select:
         - 0
         - Fn::GetAZs: {Ref: 'AWS::Region'}
      VpcId: !Ref 'VPC'
      CidrBlock: !FindInMap ['SubnetConfig', 'PublicOne', 'CIDR']
      MapPublicIpOnLaunch: true
  PublicSubnetTwo:
    Type: AWS::EC2::Subnet
    Properties:
      AvailabilityZone:
         Fn::Select:
         - 1
         - Fn::GetAZs: {Ref: 'AWS::Region'}
      VpcId: !Ref 'VPC'
      CidrBlock: !FindInMap ['SubnetConfig', 'PublicTwo', 'CIDR']
      MapPublicIpOnLaunch: true
```

- Just a list of each resource to create and its properties, in this case YAML format
- Some minor helper functions may be built in to aid in fetching values dynamically

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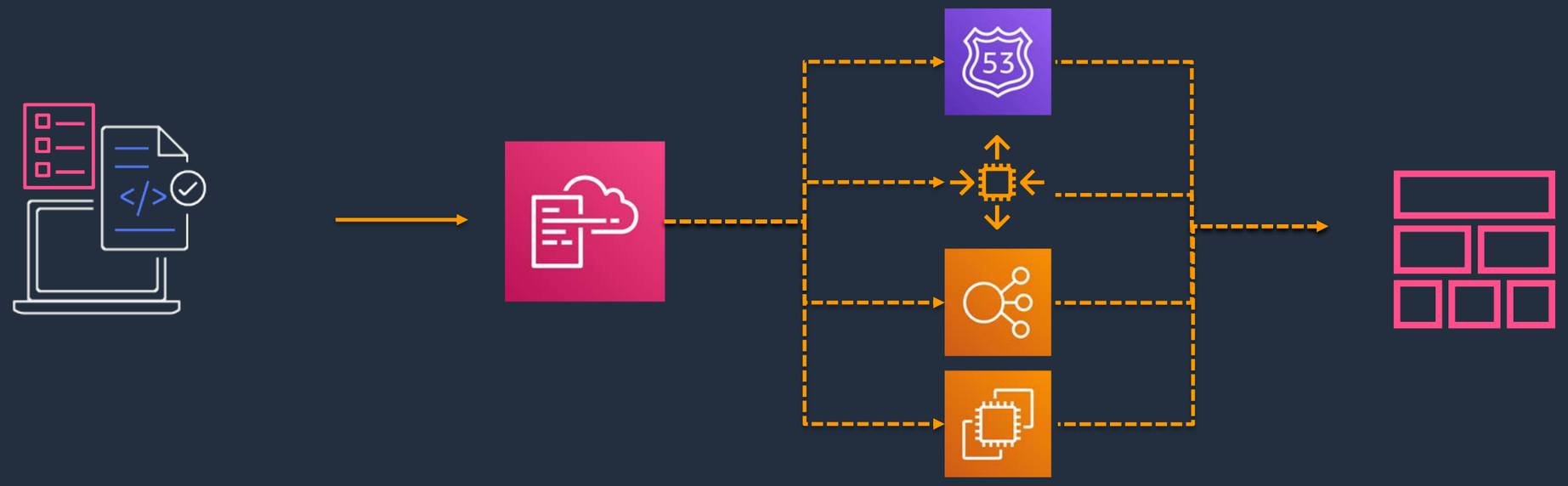
Infrastructure *as* code



Code in YAML or JSON directly or use sample templates

Upload local files or from an S3 bucket

Create stack using API via AWS CloudFormation

Stacks and resources are provisioned as a running environment

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Infrastructure *is* code (in your favorite programming language) with the AWS CDK

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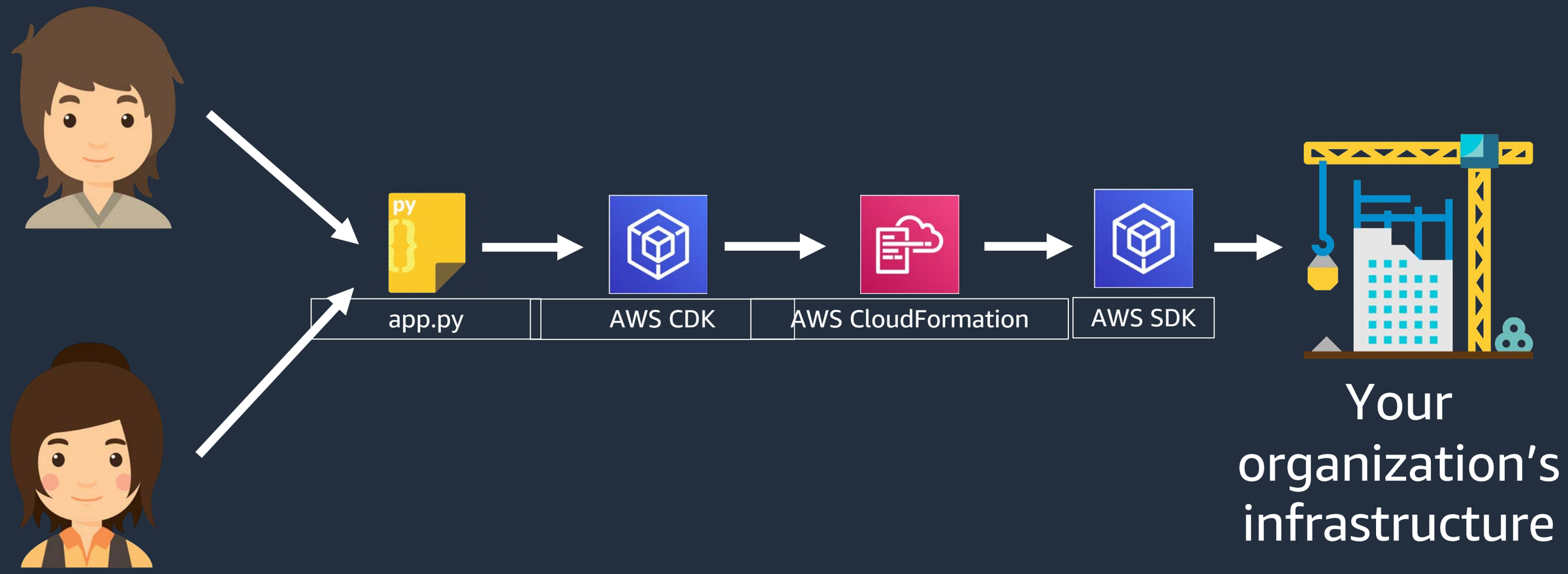
Level 3: AWS Cloud Development Kit (AWS CDK)



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AWS CDK

An open-source multi-language software development framework for modeling cloud infrastructure as reusable components

```
using Amazon.CDK;
using Amazon.CDK.AWS.S3;

namespace DemoCdk
{
    public class DemoStack : Stack
    {
        public DemoStack(Construct parent, string id, IStackProps props):
               base(parent, id, props)
        {
            new Bucket(this,
                       "MyFirstBucket",
                       new BucketProps { Versioned = true }
            );
        }
    }
}
```

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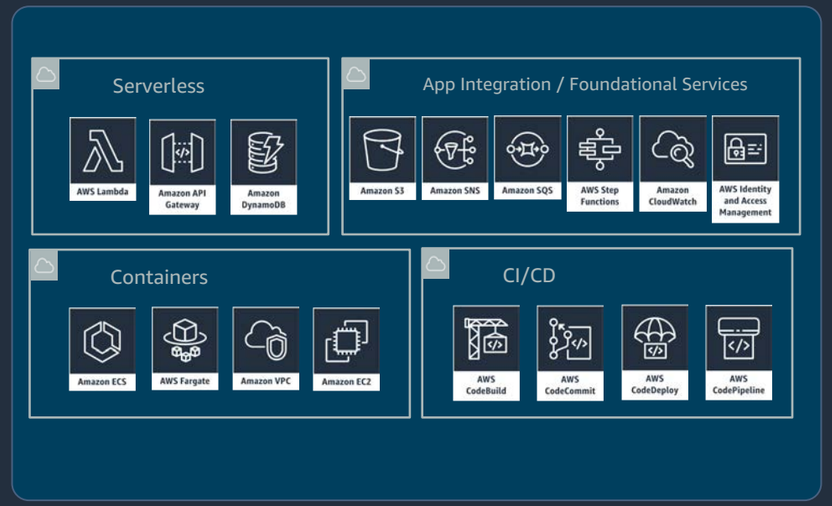
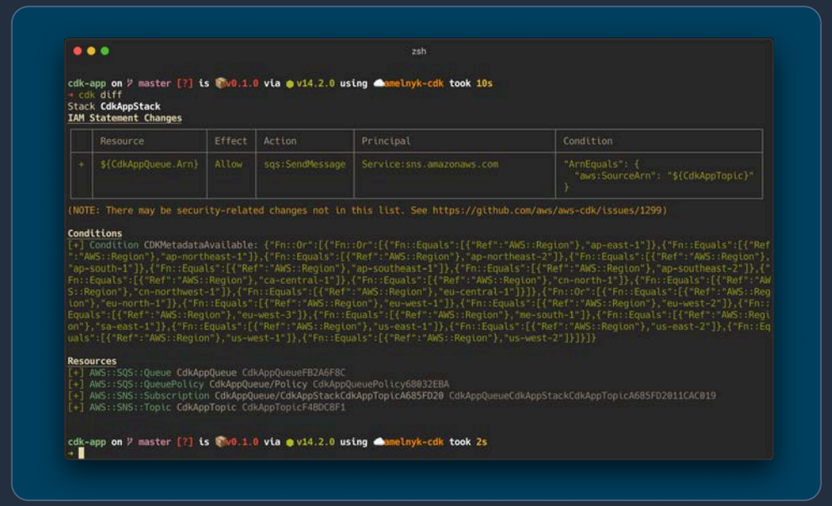
Main Components

Core Framework



AWS Construct Library



AWS CDK CLI

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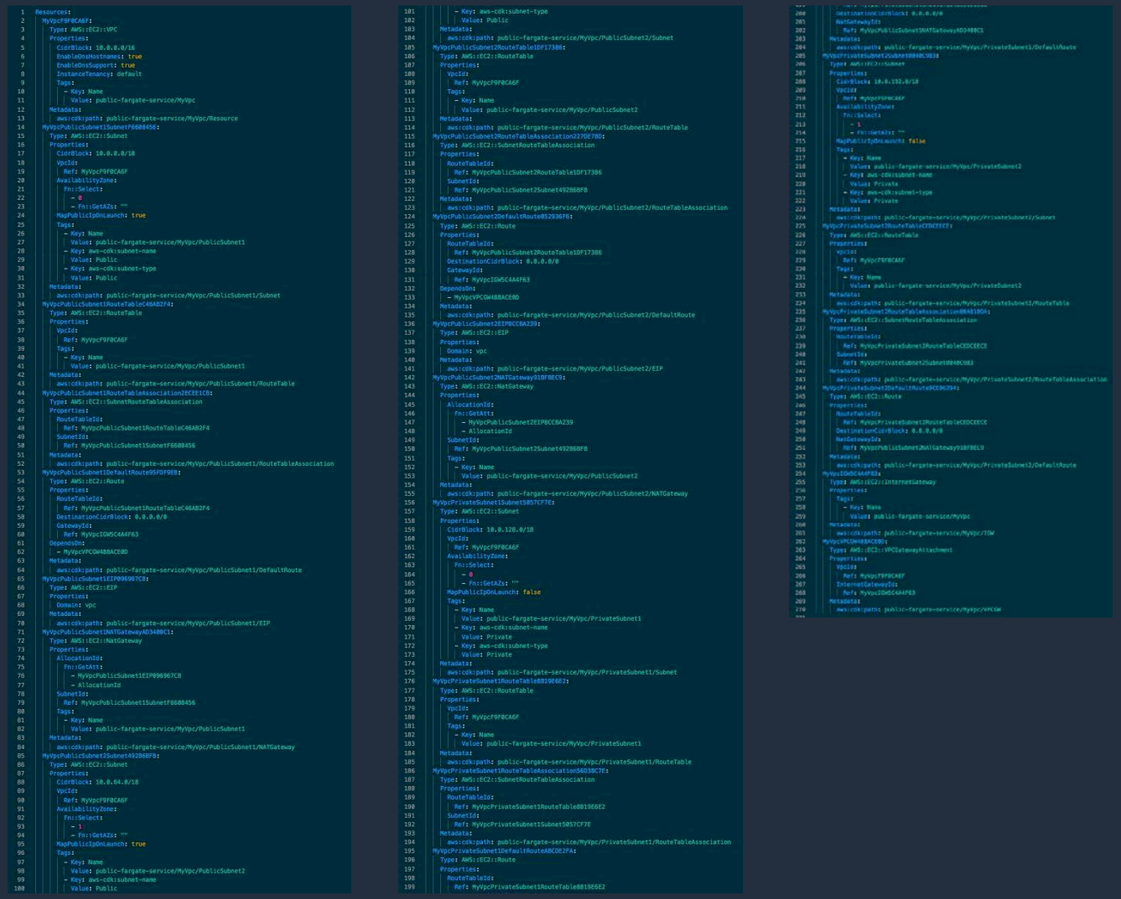
One CDK construct expands to many underlying resources



270 lines of AWS CloudFormation YAML I don’t have to write!

```
// Network for all the resources
vpc = ec2.Vpc (self, "MyVpc")
```

```
cdk synth
```

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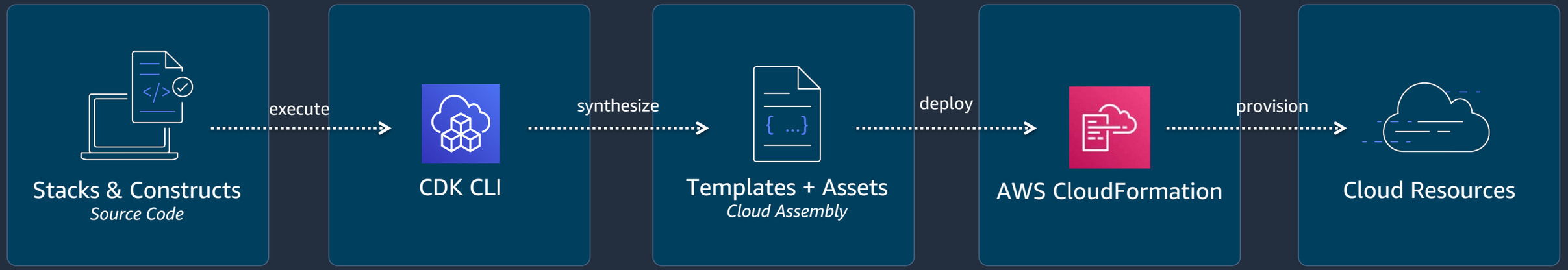
Development Workflow




```
📙 cdk init          // create new project
🛠️ pip install      // install dependancies
🧬 cdk synth         // create templates and assets
🔍 cdk diff          // check what will change
🚀 cdk deploy        // push changes to the cloud
```

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Demo

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CDK Prerequisites and Installation

- Python
- AWS CLI
- AWS Account & User

Install the AWS CDK Toolkit globally using the following npm command:

```
npm install -g aws-cdk
```

Verify correct installation and print the version number of the AWS CDK:

```
cdk --version
```

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CDK Constructs

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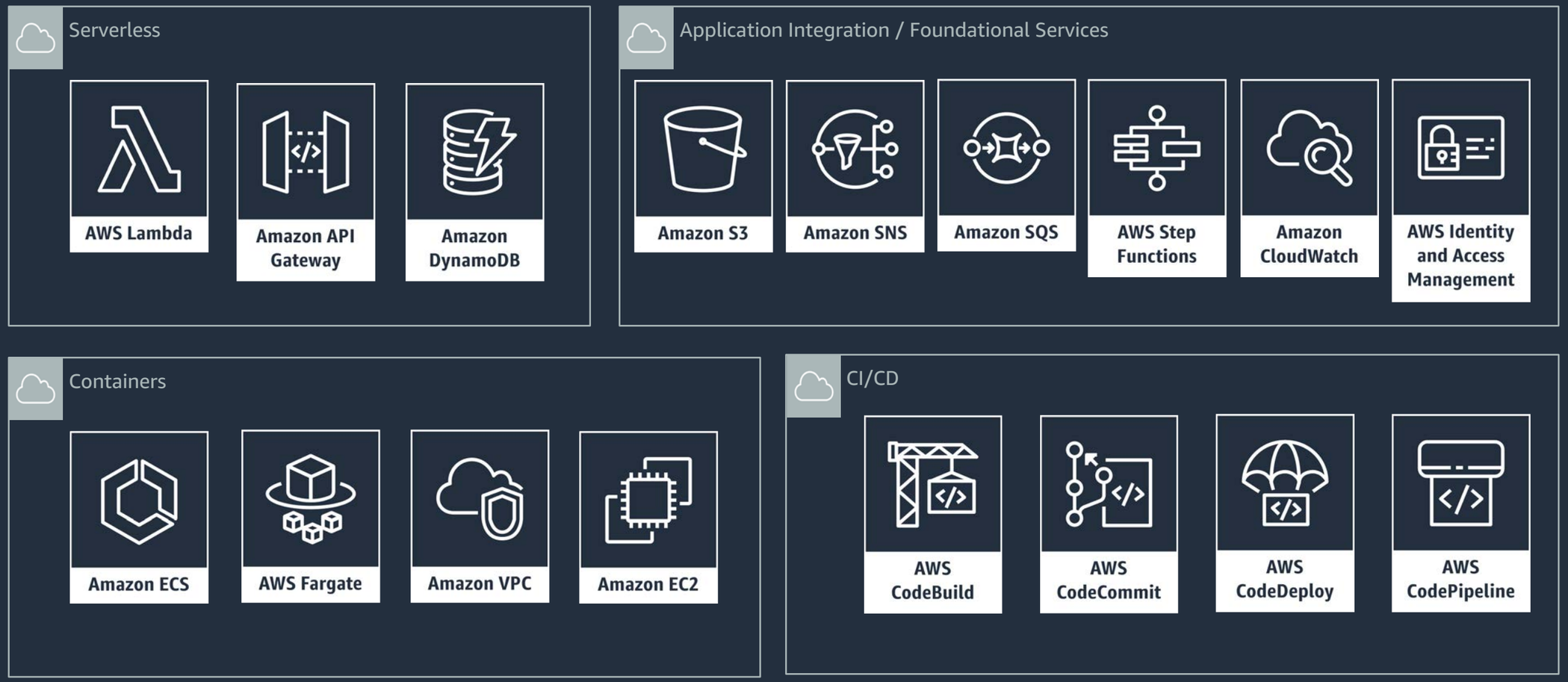
AWS Construct Library



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Construct Levels

L3+	Purpose-built constructs	Opinionated abstractions
L2	AWS Constructs	High level service constructs
L1	CloudFormation Resources	Automatically generated

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L1

```
new s3.CfnBucket(this, "myBucket", {bucketName: "my-bucket"});
```

cdk synth

```yaml
Resources:
  myBucket:
    Type: AWS::S3::Bucket
    Properties:
      BucketName: my-bucket
```

- Generated mappings from CloudFormation Specification
- abc.CfnXyz → AWS::ABC::XYZ CloudFormation Ressuorce
- ec2.CfnInstance → AWS::EC2::Instance
- kms.CfnKey → AWS::KMS::Key

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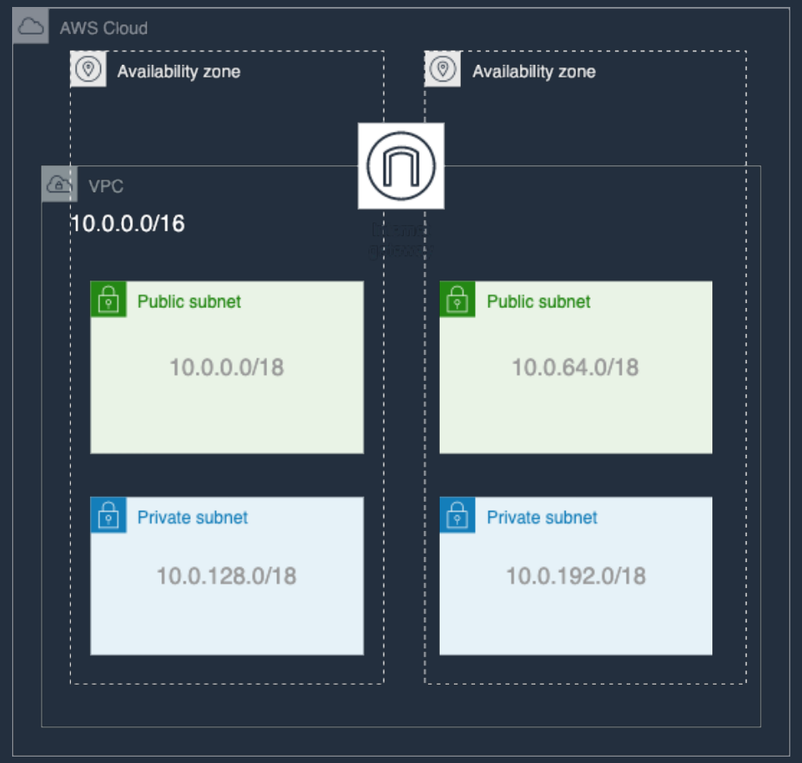
L2

```
new ec2.Vpc(this, 'MyVPC');
```

cdk synth



- Ready-to-use VPC setup
- 65536 IPs split equally between 4 subnets
- If you provide a region → adjusted to 3 AZs
- Everything is optional, change any parameter
- Sane default values

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L2

```
export class CdkAppStack extends cdk.Stack {
  constructor(scope: cdk.App, id: string, props?: cdk.StackProps) {
    super(scope, id, props);

    let table = new ddb.Table(this, "table", {
      partitionKey: { name: "id", type: ddb.AttributeType.STRING },
    });
    let inputBucket = new s3.Bucket(this, "outputBucket");
    const myLambdaFunction = new lambda.Function(this, "myFunction", {
      code: Code.fromAsset("lambda_folder"),
      handler: "function_file.function_name",
      runtime: lambda.Runtime.PYTHON_3_8,
    });

    inputBucket.grantRead(myLambdaFunction);
    table.grantWriteData(myLambdaFunction);
  }
}
```

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L3

```
new ecs_patterns.ApplicationLoadBalancedFargateService(this, "FargateService", {
  cluster,
  taskImageOptions: {
    image: ecs.ContainerImage.fromRegistry("amazon/amazon-ecs-sample"),
  },
});
```

829 line CloudFormation template

AWS VPC

- Subnets
- EIP
- NAT Gateways
- Internet Gateway
- Route
- Route Table

Elastic Load Balancer

- Security Group
- Security Group Egress
- Security Group Ingress
- Task Definition
- Listener
- Target Group

Fargate Service

- IAM Roles
- IAM Policies
- Log Group
- Configuration

ECS Task Definition

- image
- CPU
- memory
- port

"amazon-ecs-sample" image

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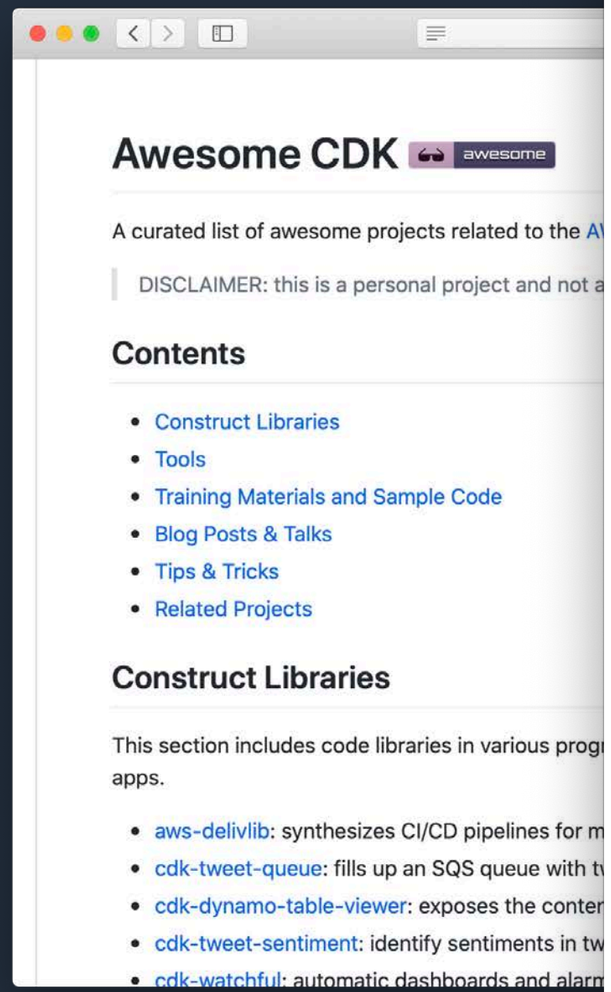
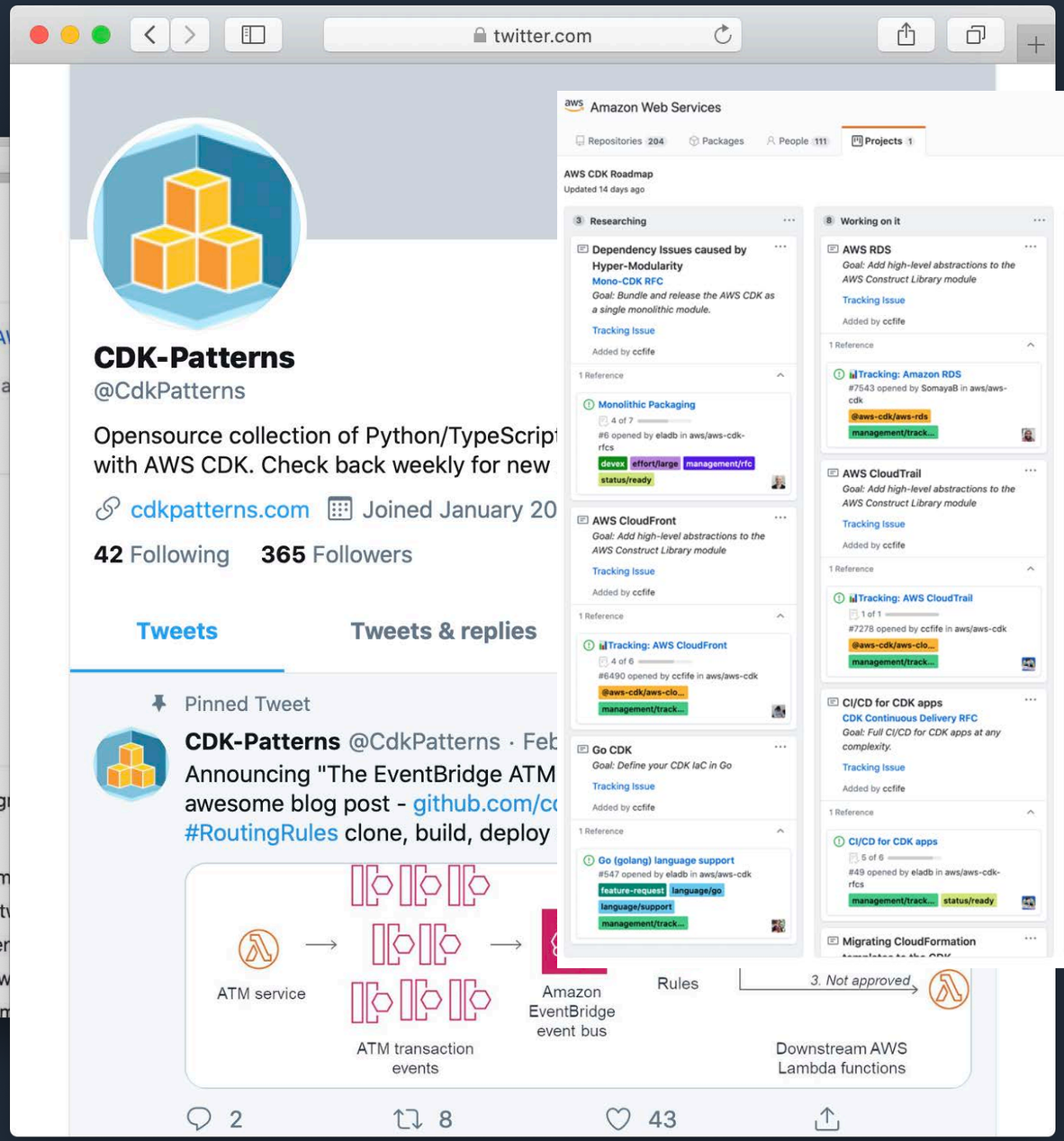
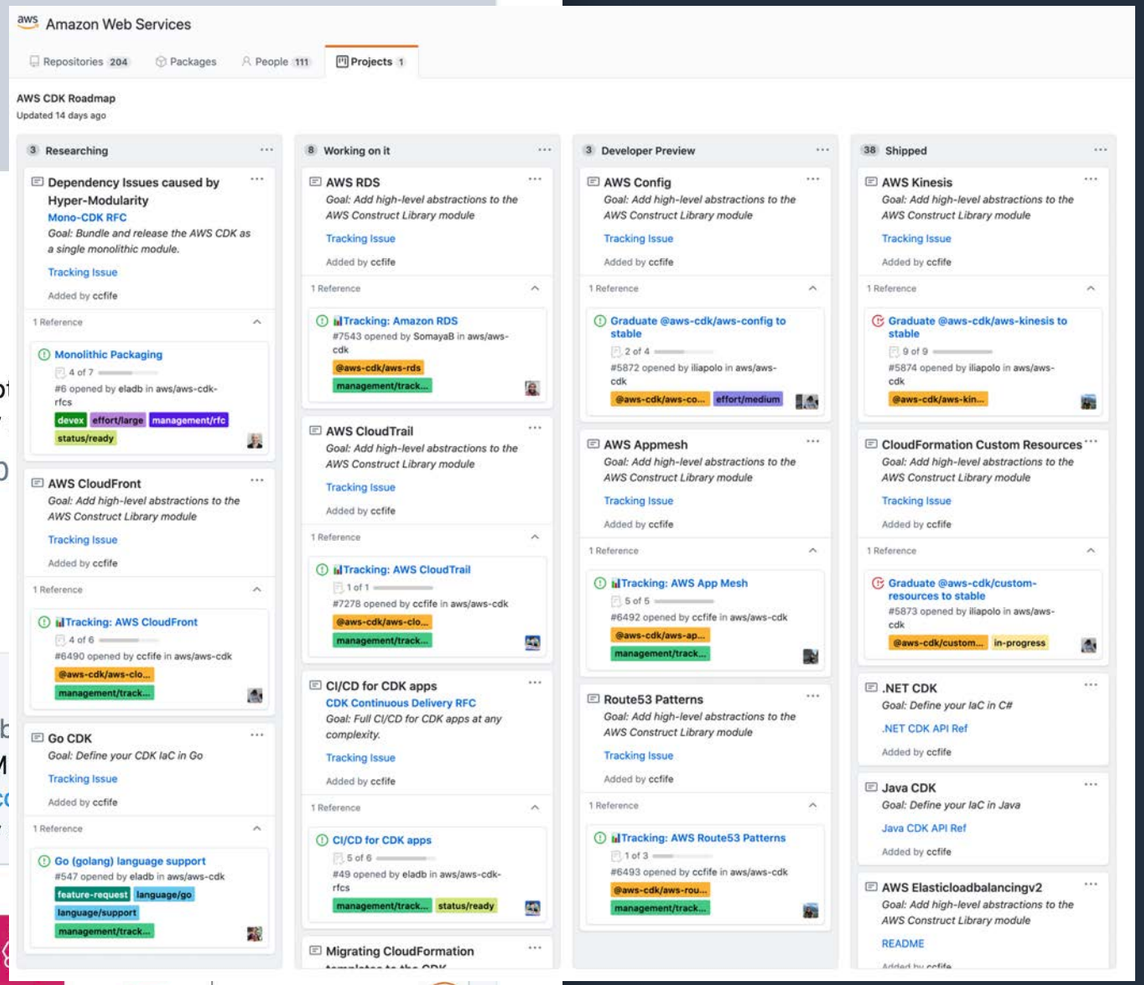
Open Ecosystem







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Benefits of CDK

- Use logic (if statements, for-loops, etc.) when defining your infrastructure
- Use object-oriented techniques to create a model of your system
- Organize your project into logical modules
- Reuse your infrastructure as a library
- Use your existing code review workflow
- Code completion within your IDE

```
1 reference
public HelloCdkStack(Construct scope, string id, IStackProps props = null) :
        base(scope, id, props)
{
    new Bucket(this, "MyFirstBucket", new BucketProps
    {
        Versioned = true,
        RemovalPolicy = RemovalPolicy.
    });
}
```

```
DESTROY                    RemovalPolicy DESTROY
RETAIN
SNAPSHOT
```

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Next Steps

Get started

- **cdkworkshop.com**
- aws.amazon.com/cdk
- aws-samples/aws-cdk-examples/python

Contribute

- gitter.im/awslabs/aws-cdk
- aws/aws-cdk

Community Resources

- cdkpatterns.com
- cdk8s.io
- awscdk.io

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