All You Need to Know About Auto Scaling

(based on CMP 201 from re:Invent 2015)

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Auto Scaling – Why it’s needed

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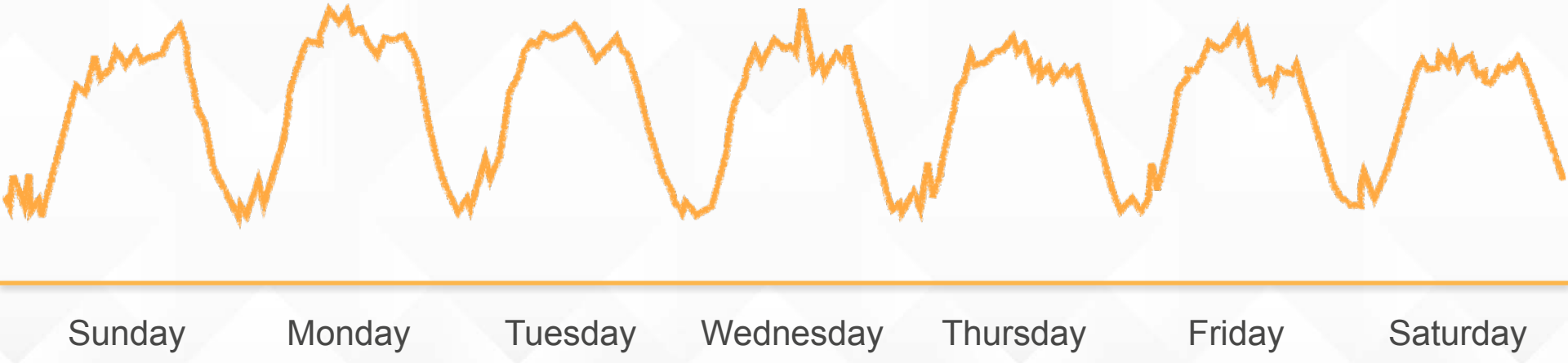
Typical weekly traffic to Amazon.com



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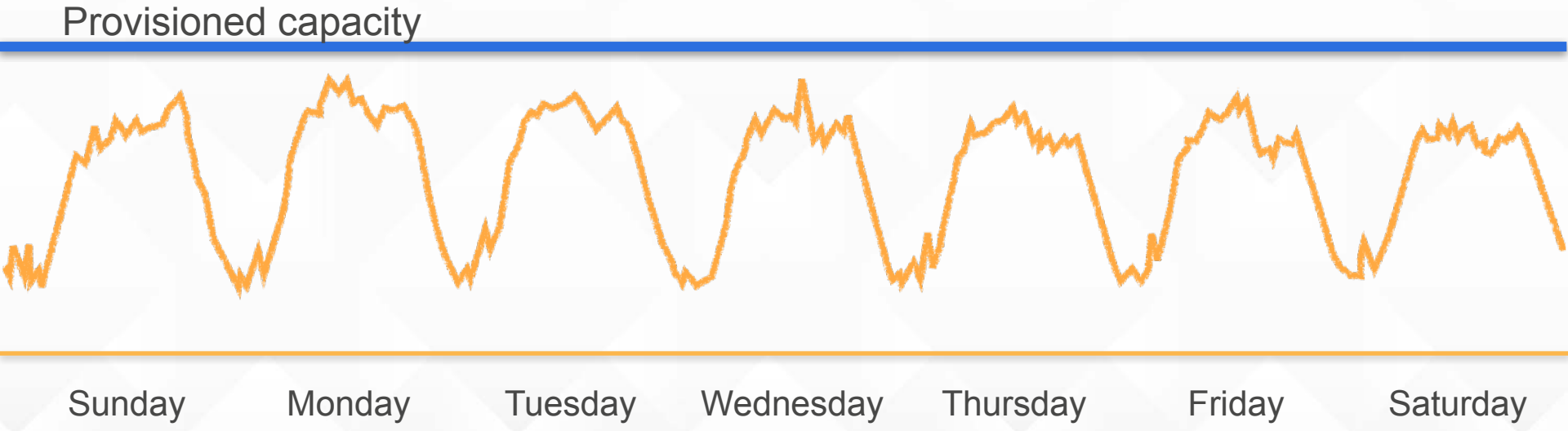
Typical weekly traffic to Amazon.com



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November traffic to Amazon.com

November

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November traffic to Amazon.com

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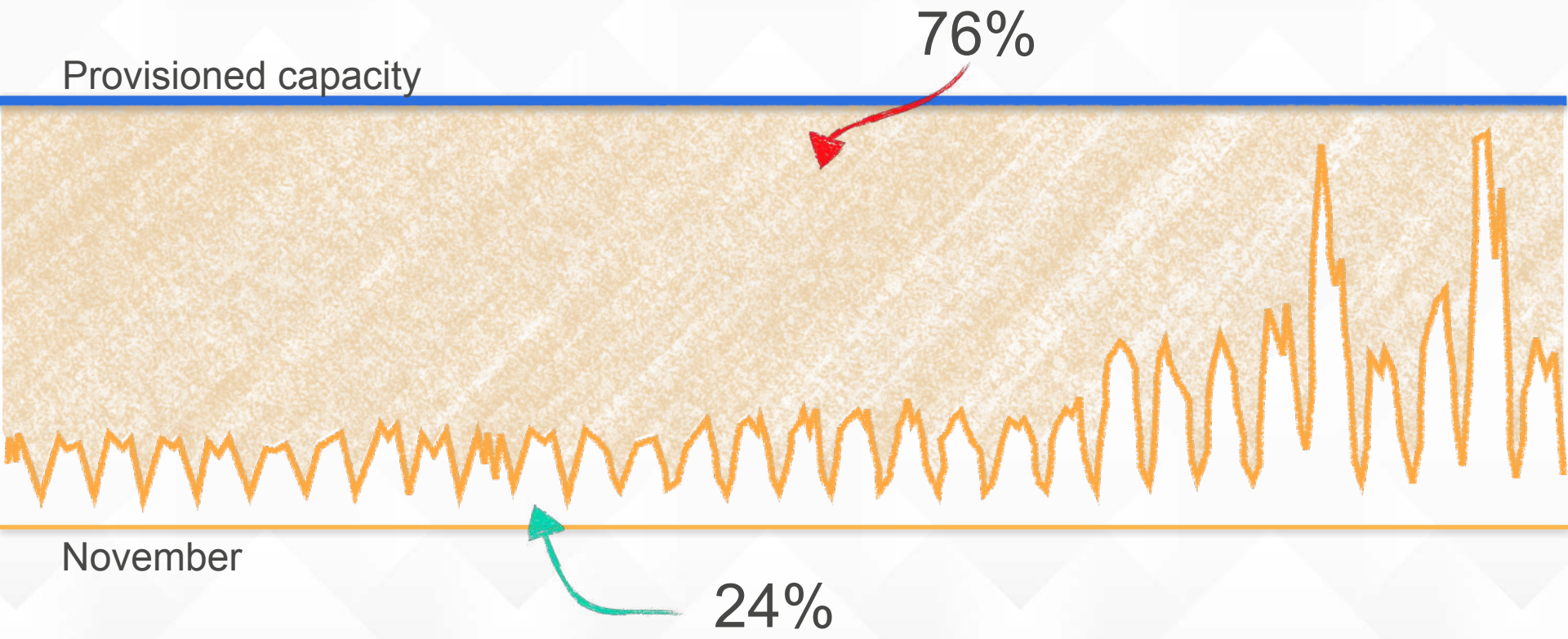
November traffic to Amazon.com



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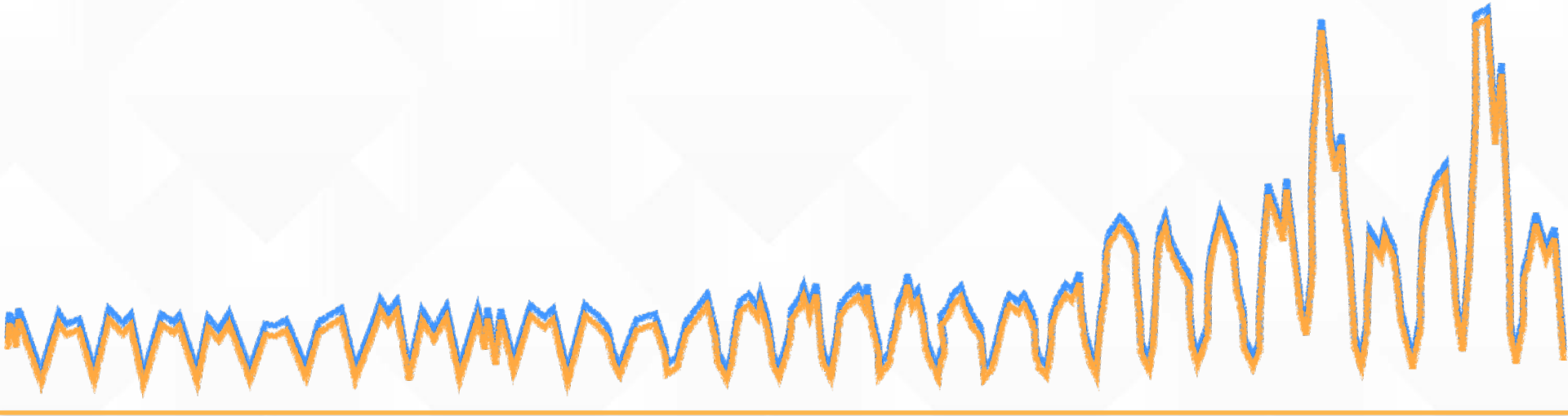
November traffic to Amazon.com



November

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Auto Scaling – The Basics

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Auto Scaling Concepts

Auto Scaling Groups

- EC2 instances are managed by Auto Scaling *groups*.
- Create Auto Scaling groups by defining the minimum, maximum, and, optionally, the desired number of running EC2 instances.

Launch Configuration

- Auto Scaling groups use a *launch configuration* to launch EC2 instances.
- Provides information about the AMI and EC2 instance types/size

Scaling Policy

- A scaling policy tells Auto Scaling when and how to scale.
- Create a scaling policybased on the occurrence of specified conditions (dynamic scaling) or create a policy based on a specific schedule.

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Auto Scaling Groups

- Always keep **minimum** number of instances running
- Launch or terminate instances to meet **desired capacity**
- Never start more than **maximum** number of instances
- Keeps capacity **balanced** across AZs

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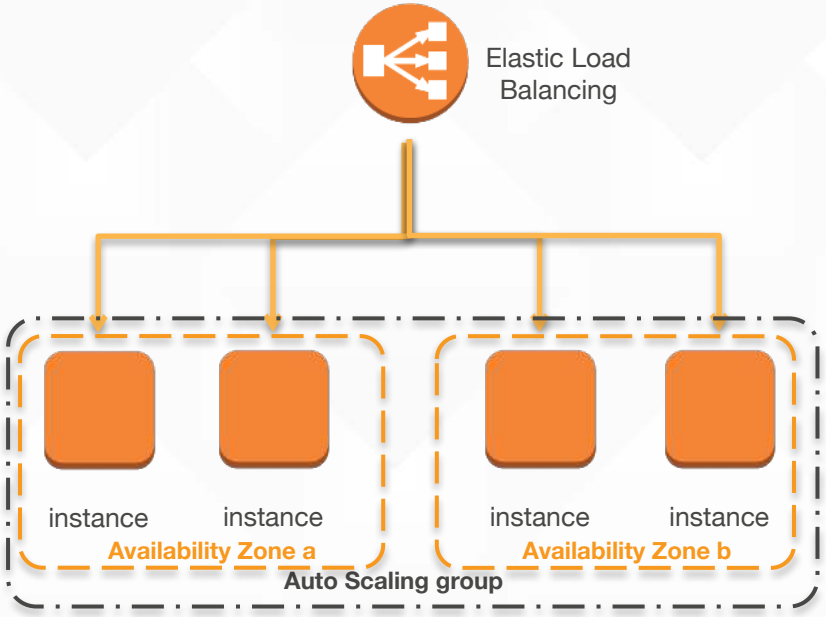
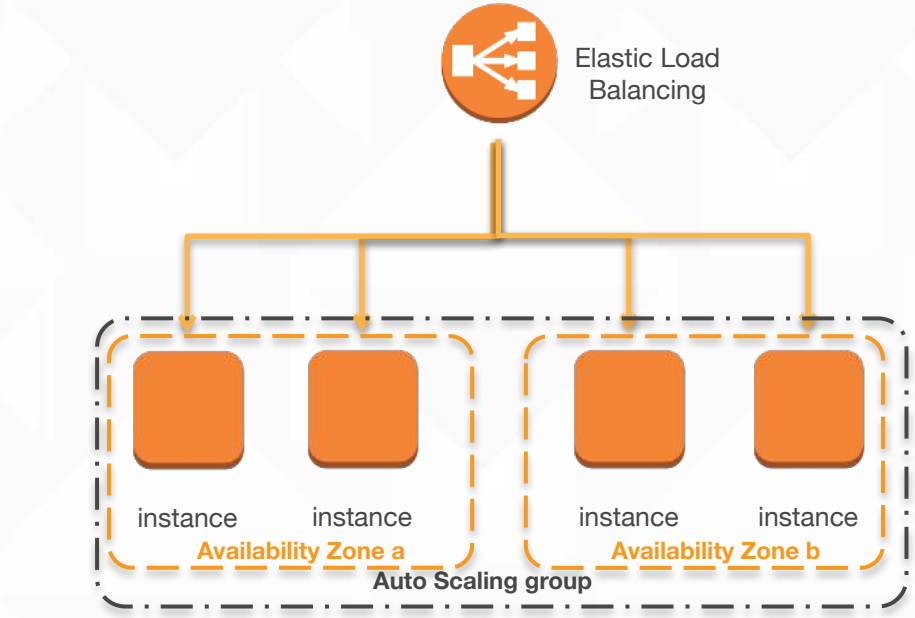


Minimum = 2

Maximum = 10

Desired # of instances = 4



Minimum = 2

Maximum = 10

Desired # of instances = 6

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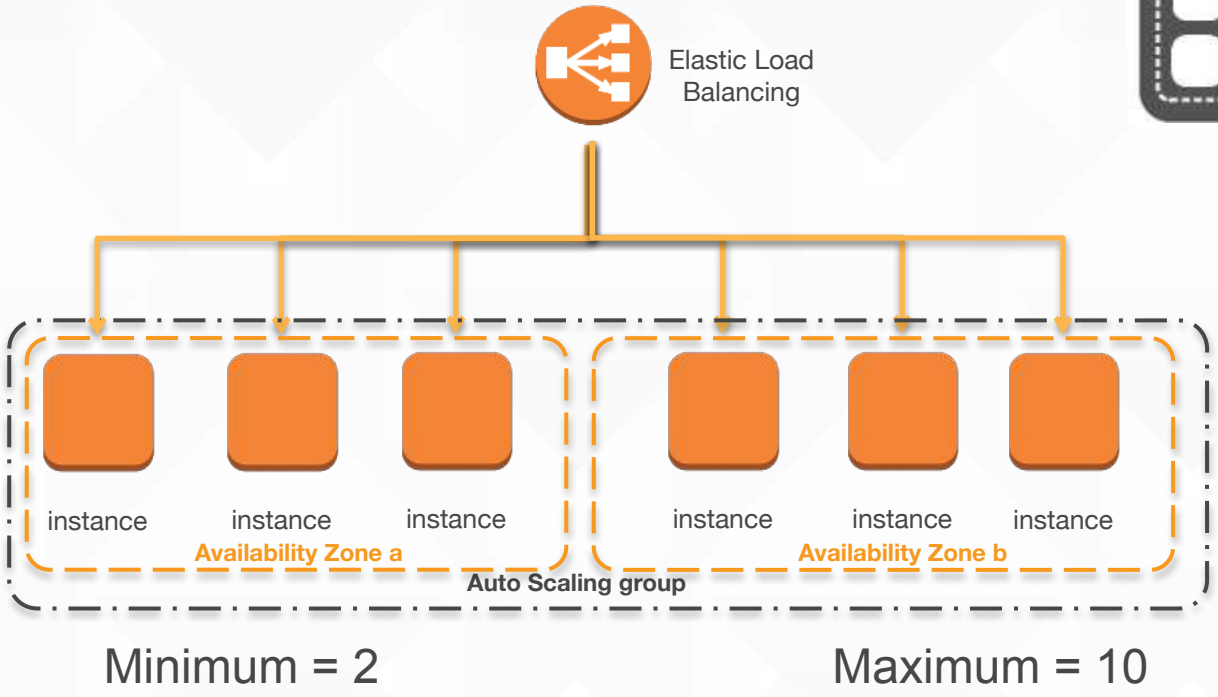

Desired # of instances = 6

Launch Configurations

Determine **what** is going to be launched:

- EC2 instance type & size
- Amazon Machine Image (AMI)
- Security groups, SSH keys, IAM instance profile
- User data

…

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Bootstrapping

Installation & setup needs to be fully automated:

- Use Amazon Machine Image (AMI) with all required configuration & software (“golden image”)
- Base AMI + install code & configuration as needed
  - Via Userdata
  - Via Chef/Puppet/Ansible/…
  - Using AWS CodeDeploy

…

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Bootstrapping

```
#!/bin/bash
yum -y update;
yum install -y ruby; yum install -y aws-cli;
cd /home/ec2-user;
aws s3 cp s3://aws-codedeploy-us-east-1/latest/ \ install . --region us-east-1;
chmod +x ./install;
./install auto;
```

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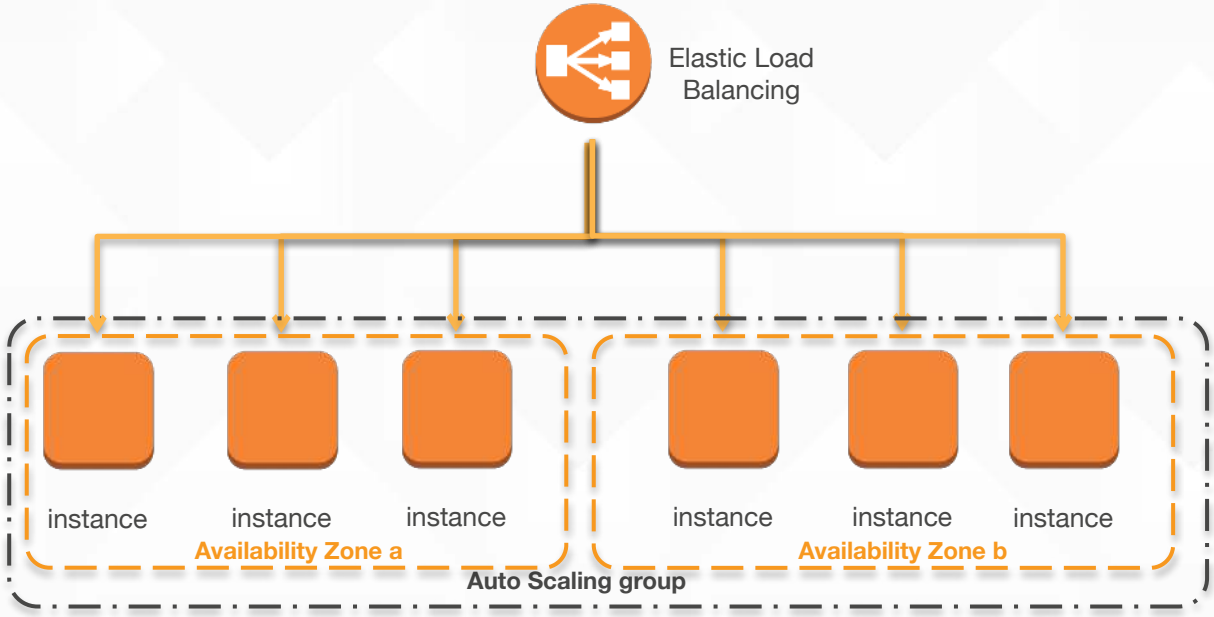

Minimum = 2

Maximum = 10

Desired # of instances = 6

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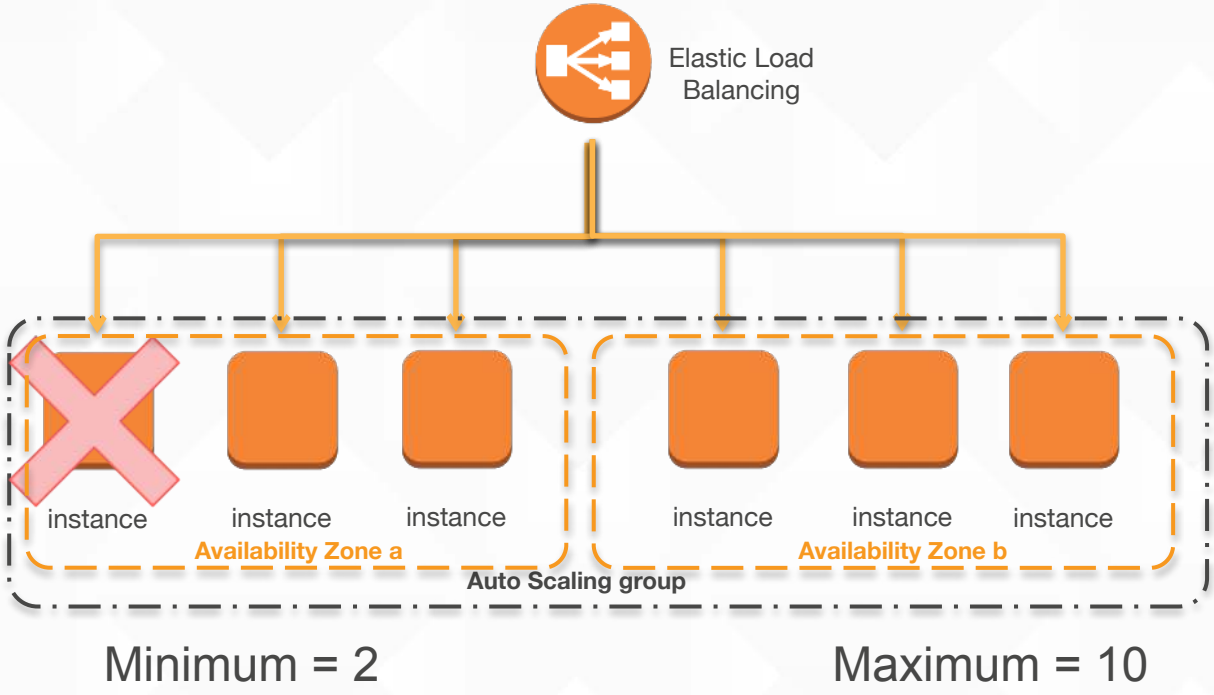

Desired # of instances = 5

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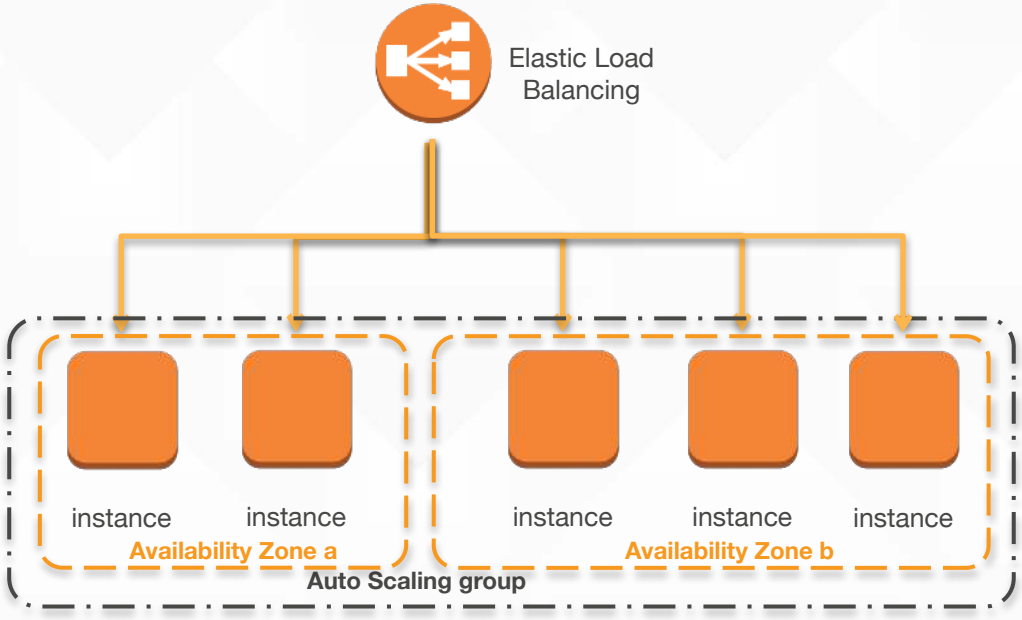

Minimum = 2

Maximum = 10

Desired # of instances **= 5**

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Termination Policies

Determine which instances are terminated first:

- Longest running
- Oldest launch configuration
- Closest to full billing hour

But: rebalancing of capacity across AZs takes precedence!

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Scaling Policies

Determine when the Auto Scaling group will scale in or out:

desired capacity > current capacity: launch instances
desired capacity < current capacity: terminate instances

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Scaling Policies

- Default: ensure current capacity of **healthy** instances remains within boundaries (never less than minimum)
- ‘Manual scaling’: modify desired capacity (via API, console, CLI) to trigger a scaling event
- Scheduled: scale in / out based on timed events
- Dynamic scaling: scale on Amazon CloudWatch metrics

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Integration with Amazon Elastic Load Balancing

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Load Balance your Auto Scaling Group

Elastic Load Balancing

- Distribute incoming web traffic automatically.
- Single point of entry for your application.
- Sends data about your load balancers and EC2 instances to Amazon CloudWatch.
- Use Elastic Load Balancing metrics to scale your application.
- Use connection draining to wait for the in-flight requests to complete.

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Load Balance your Auto Scaling Group

Elastic Load Balancing

- Configure your Auto Scaling Group to work with one or more Elastic Load Balancers
- Automatically registers new instances, deregisters on termination
- Use ELB health checks in your Auto Scaling Group
- Use Elastic Load Balancing metrics in scaling policies

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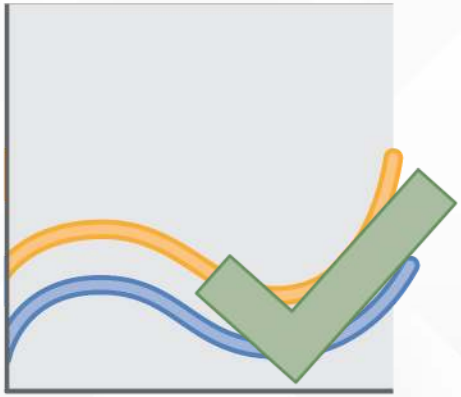
Benefits of Auto Scaling

Elasticity:

Automatically adapt capacity to demand



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Availability & Reliability

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Health Checks

- Performed periodically
- Instances are marked as unhealthy or healthy
- Unhealthy instances are terminated and replaced

  (if new number of instances < minimum or < desired capacity)

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Health Checks

- EC2 instance status:
  - Instance is unhealthy when instance state `!=` ‘`running`’ **or** system health check `==` ‘`impaired`’
- ELB health checks:
  - instance is unhealthy when ELB health check results in “`OutOfService`” (**or** EC2 health check failed)
- Manual: mark individual instances as ‘unhealthy’
  - Instance unhealthy when marked as such **or** EC2 health check failed. Use to integrate with external monitoring systems.

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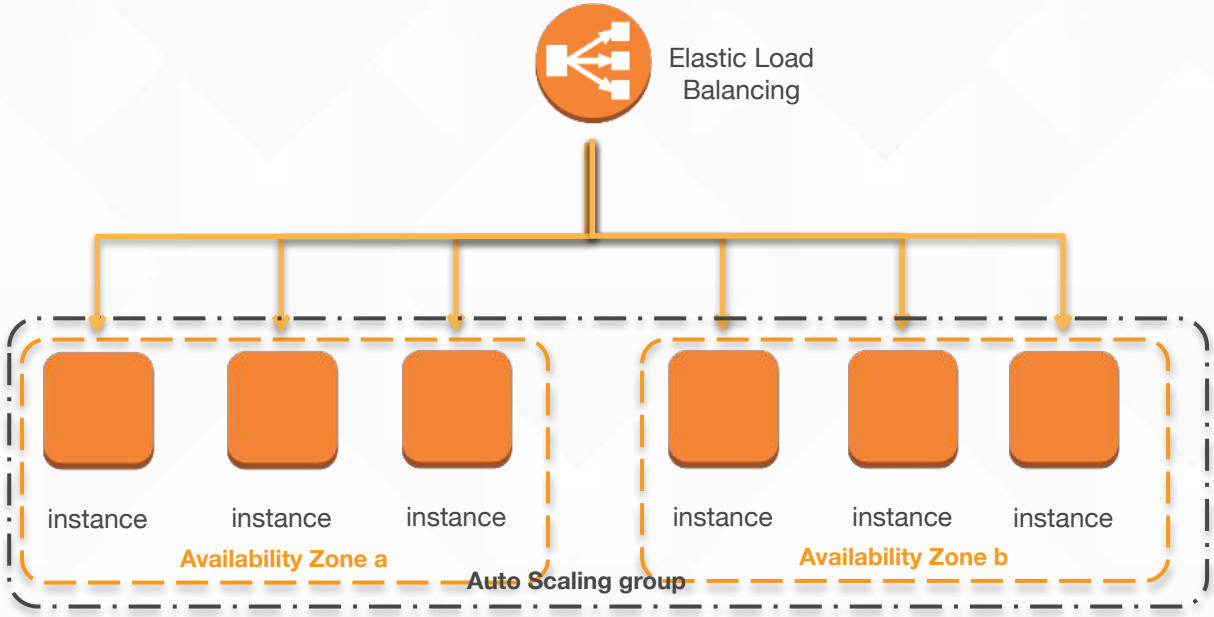

Minimum = 2

Maximum = 10

Desired # of instances = 6

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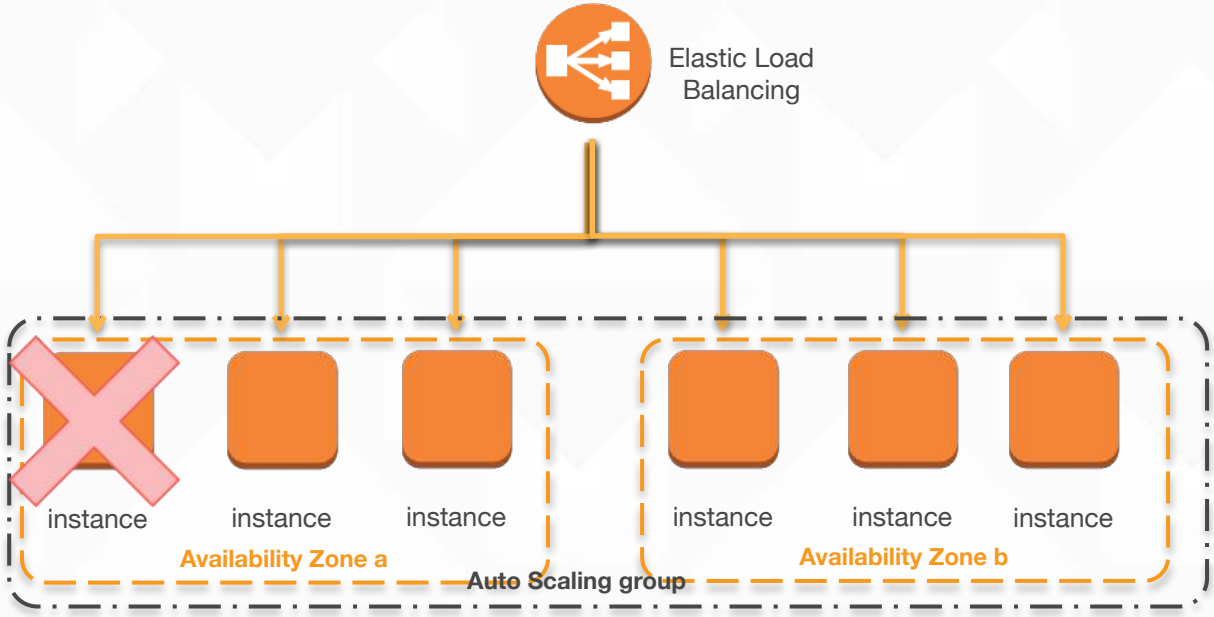
Unhealthy Instances Get Replaced…



Minimum = 2

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Desired # of instances = 6

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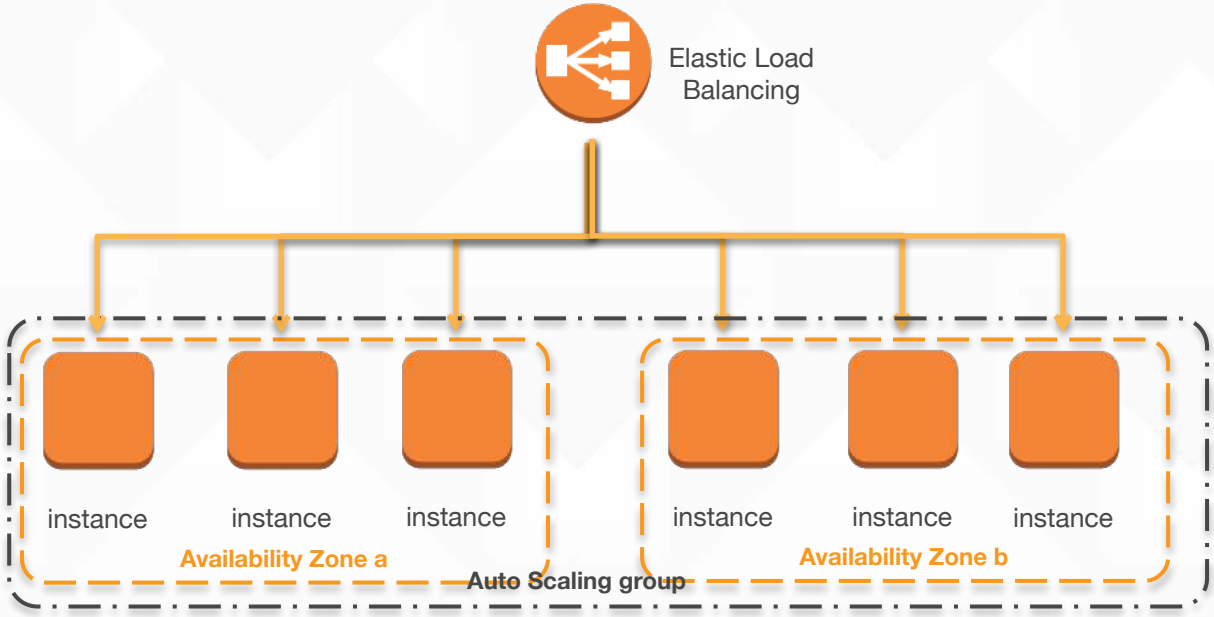
Unhealthy Instances Get Replaced…



Minimum = 2

Maximum = 10

Desired # of instances = 6

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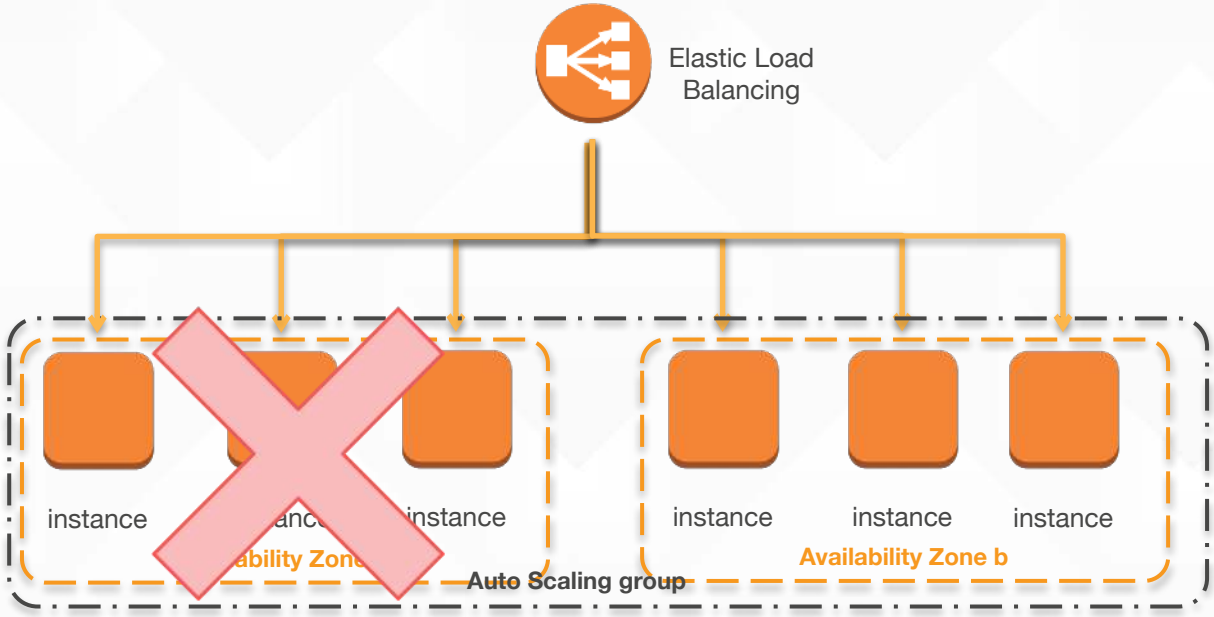
Unhealthy Instances Get Replaced…



Minimum = 2

Maximum = 10

Desired # of instances = 6

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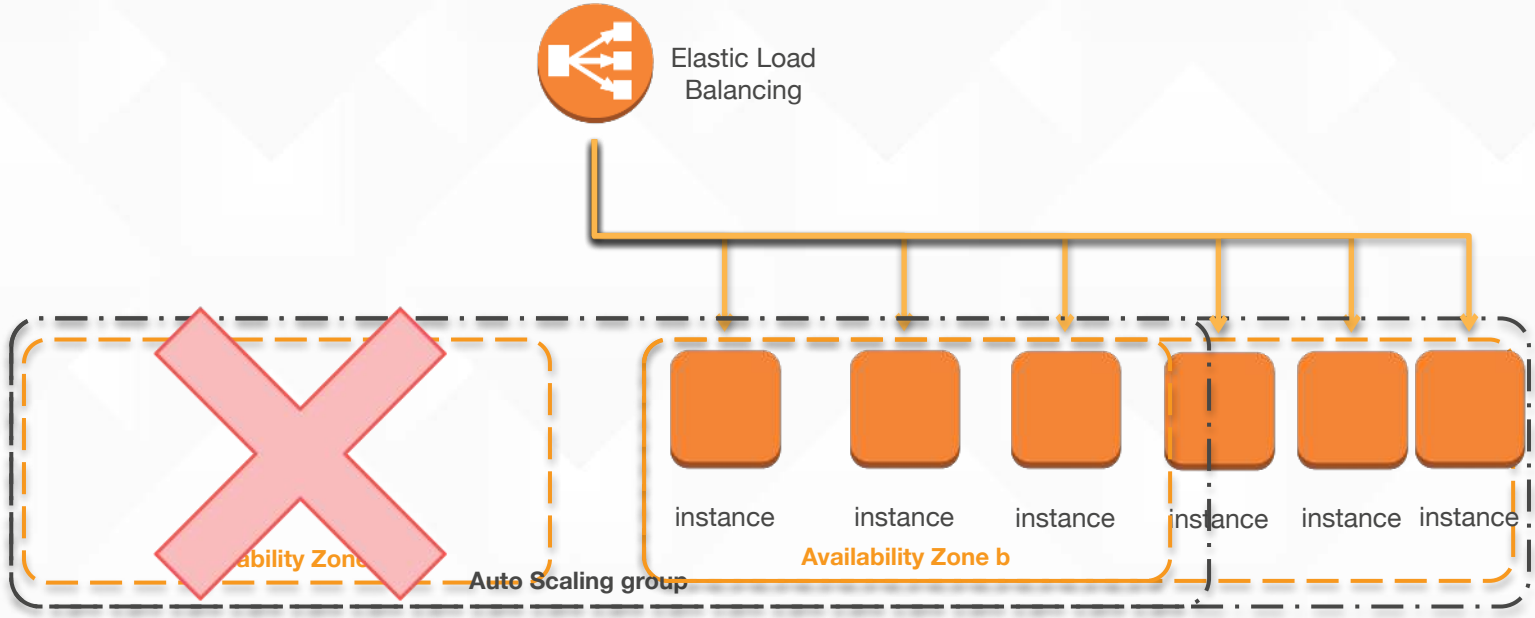
…In a Different AZ if Necessary



Minimum = 2

Maximum = 10

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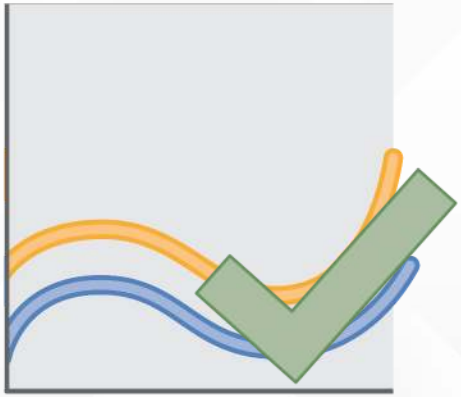
Benefits of Auto Scaling

Elastic:

Automatically adapt capacity to demand



Reliable:

Counteract failures of instances or AZs

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Scaling Policies

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Scaling Policies

Can change capacity of the group in 3 different ways:

- Set fixed capacity, e.g., desired capacity = 4 instances
- Add / remove fixed number of instances, e.g., + 2
- Add / remove percentage of existing capacity, e.g. +20%

Can be either manual, scheduled or dynamic

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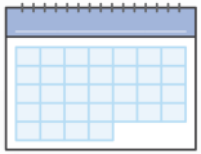
Scheduled Policies

cron-like syntax for recurring scaling events

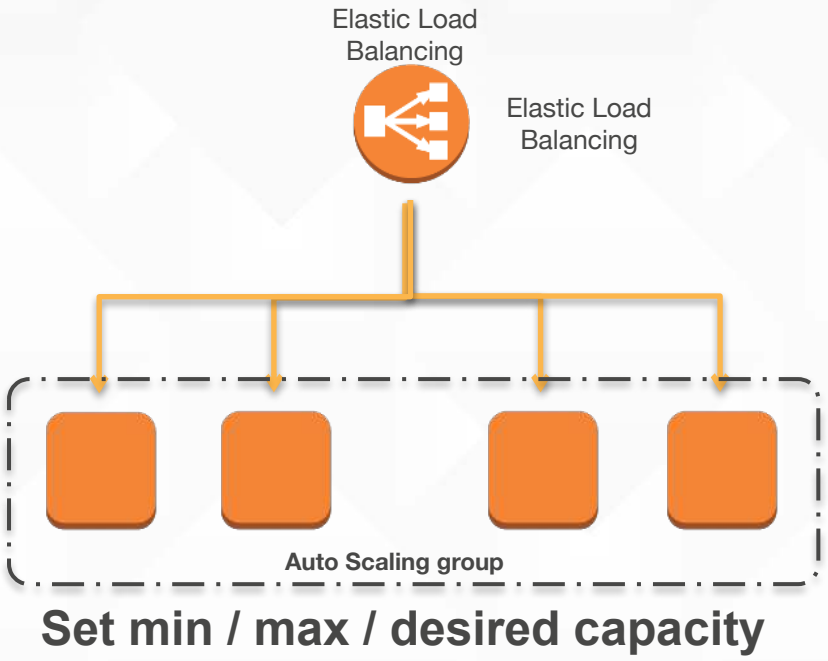
Scaling event

Schedule individual events



Scaling event

(up to 125 events per month per group)



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Dynamic Scaling Policies

Trigger scaling events based on demand:

- Demand is measured based on metrics
- Changes in metrics can be mapped to scaling policies

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Amazon CloudWatch

Amazon **CloudWatch**: A web service that enables you to monitor and manage various metrics, and configure alarm actions based on data from those metrics.

A **metric** is a variable that you want to monitor, e.g., CPU usage or incoming network traffic.

A **CloudWatch *alarm*** is an object that monitors a single metric over a specific period.

The alarm changes its **state** when the value of the metric breaches a defined range and maintains the change for a specified number of periods.

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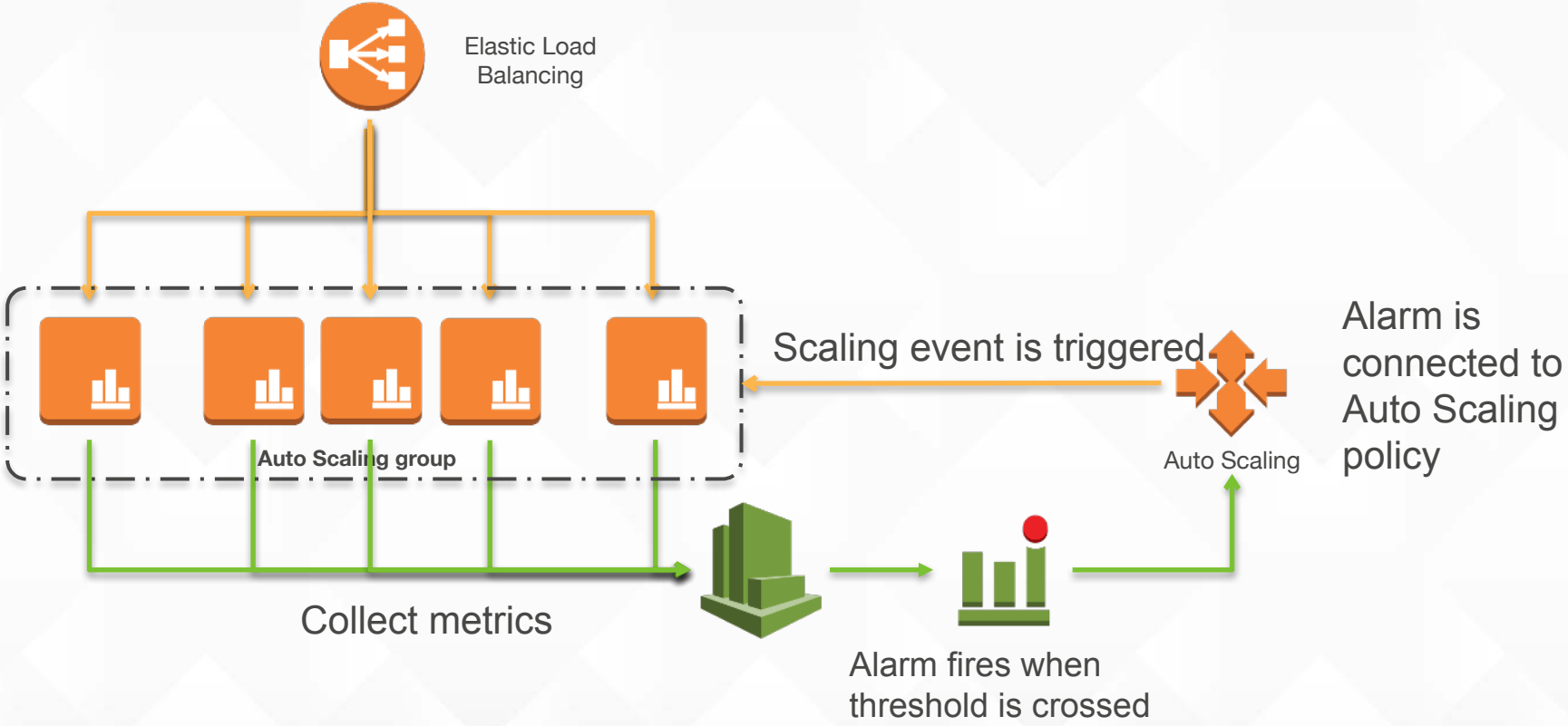
How Alarms Work



Amazon CloudWatch can aggregate metrics across pre-defined dimensions, e.g., aggregate average CPU utilization of all EC2 instances in an Auto Scaling group

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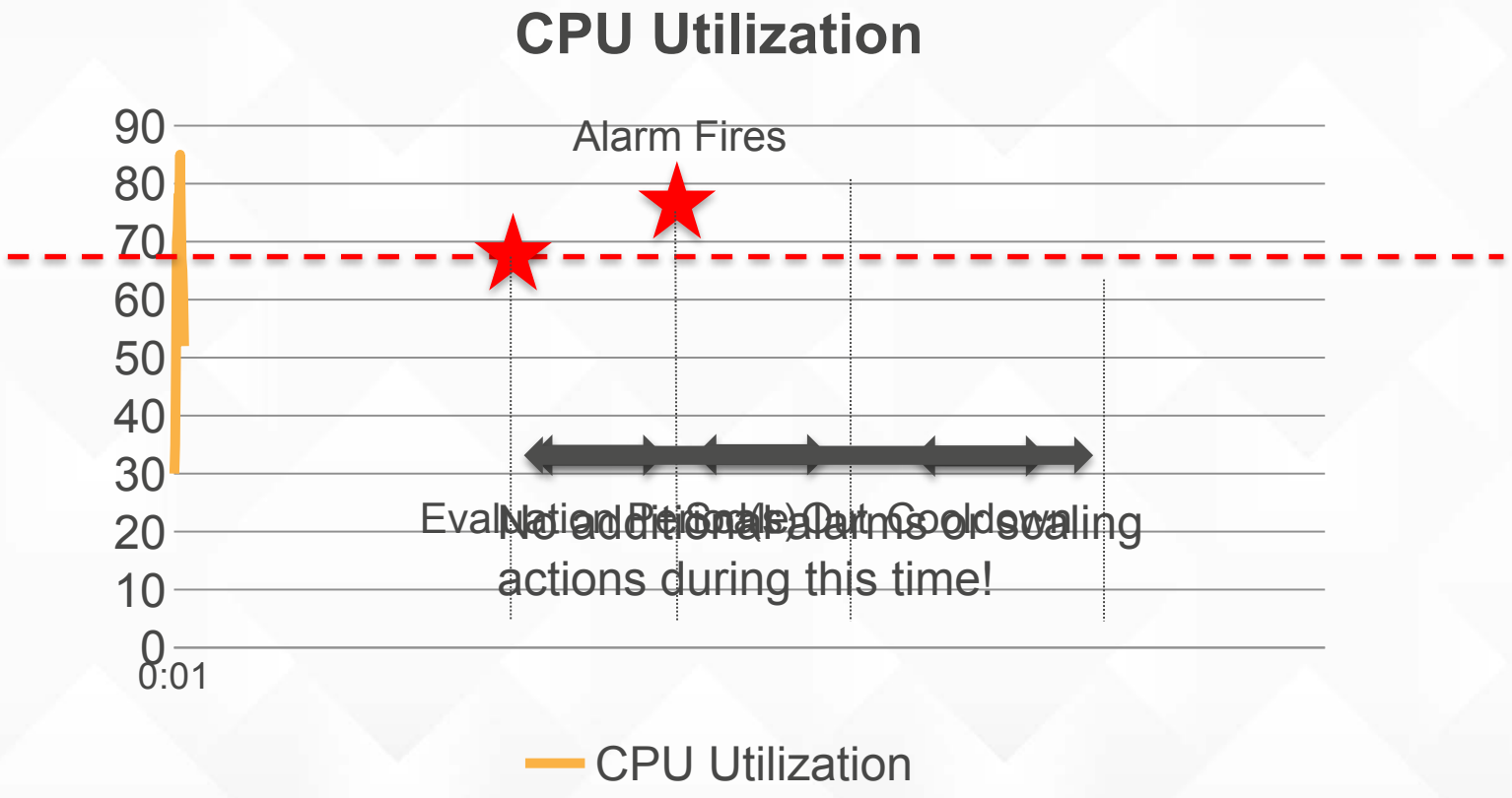
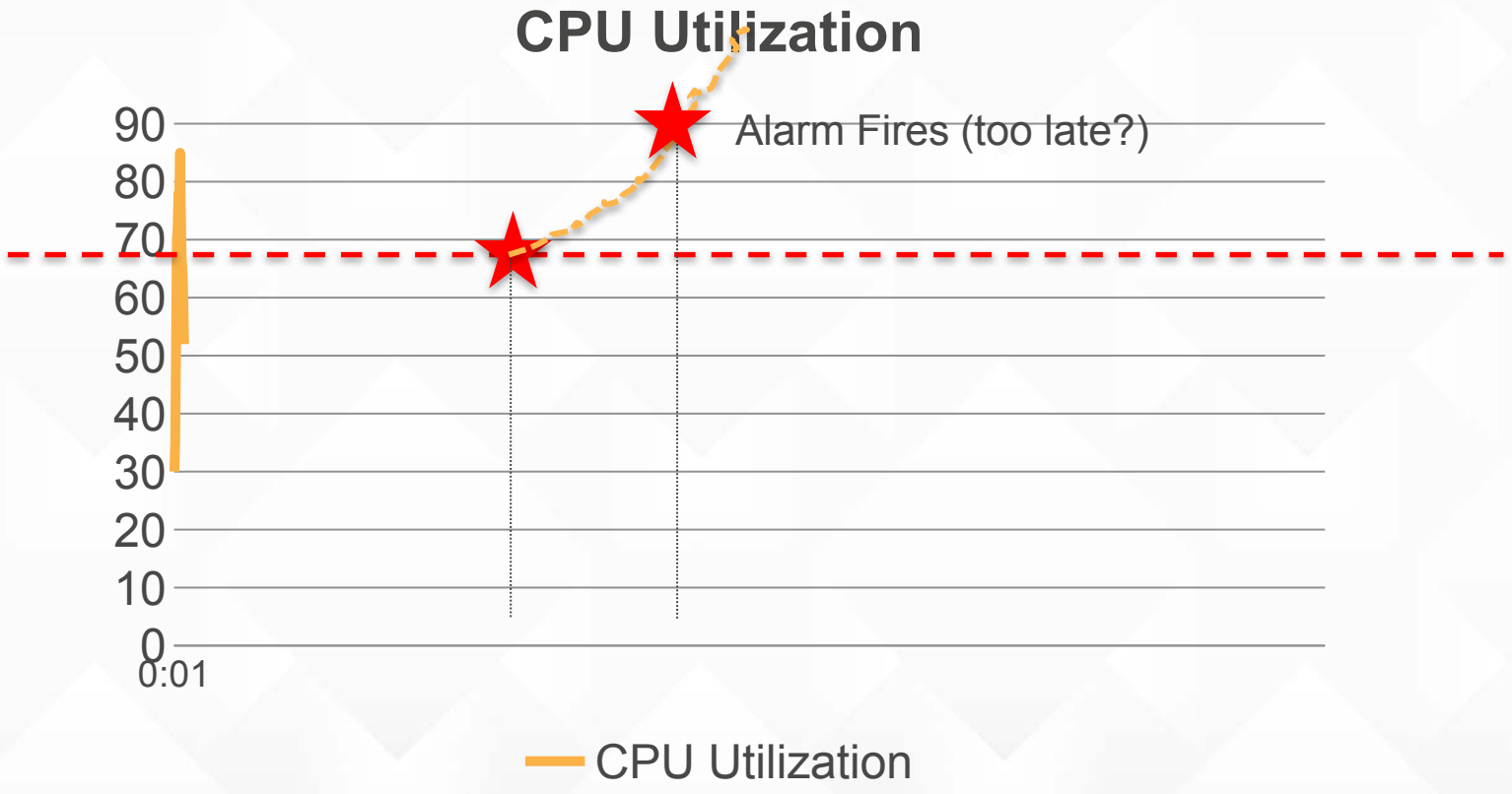

CPU Utilization
90
80
70
60
50
40
30
20
10
0
0:01
Alarm Fires
Evaluation Period
Scale Out Cooldown
No additional alarms or scaling actions during this time!
CPU Utilization



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Step Scaling Policies

Define **multiple steps** in the same policy.

The appropriate scaling step is selected based on the value of the **metric** that triggered the alarm, i.e., based on the magnitude of the breach.

Step scaling policies are **evaluated continuously**.

No locking – alarms keep getting evaluated even while scaling.

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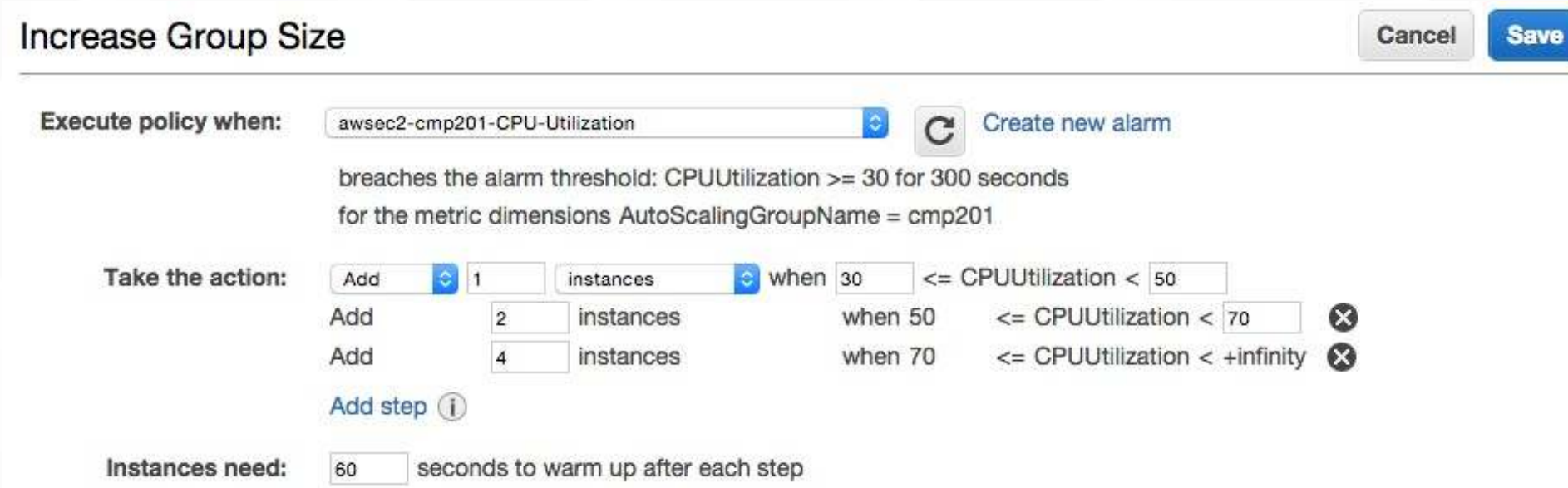
Step Scaling Policies



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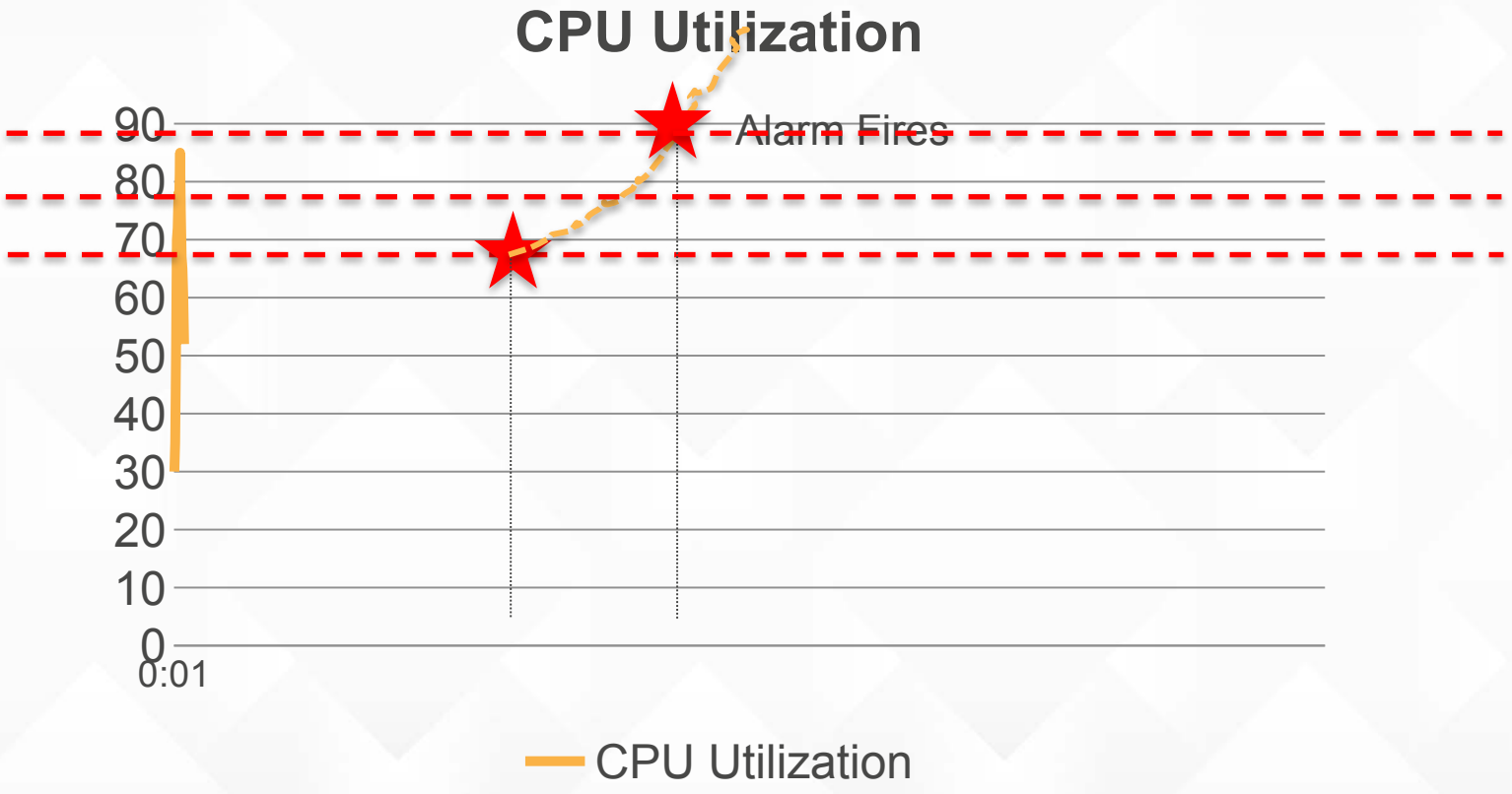

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Pros & Cons

Simple scaling policies

- Reaction always the same, independent of size of breach
- Locks the Auto Scaling group when a scaling action is run, i.e., single event at a time
- Evaluates metric only when no scaling action ongoing
- Cooldown takes effect after scaling action is complete

Step scaling policies

- Continuously evaluates metrics
- “Instant” reaction
- Does not ‘lock’ the Auto Scaling group while action is evaluated
- Cooldown not supported (use ‘warmup’ period instead)

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Lifecycle hooks

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Why? – Common Use Cases

- Assign Elastic IP address on launch
- Register new instances with DNS, message queues,…
- Pull down log files before instance is terminated
- Investigate issues with an instance before terminating it
- …
- Scaling containers on ECS cluster

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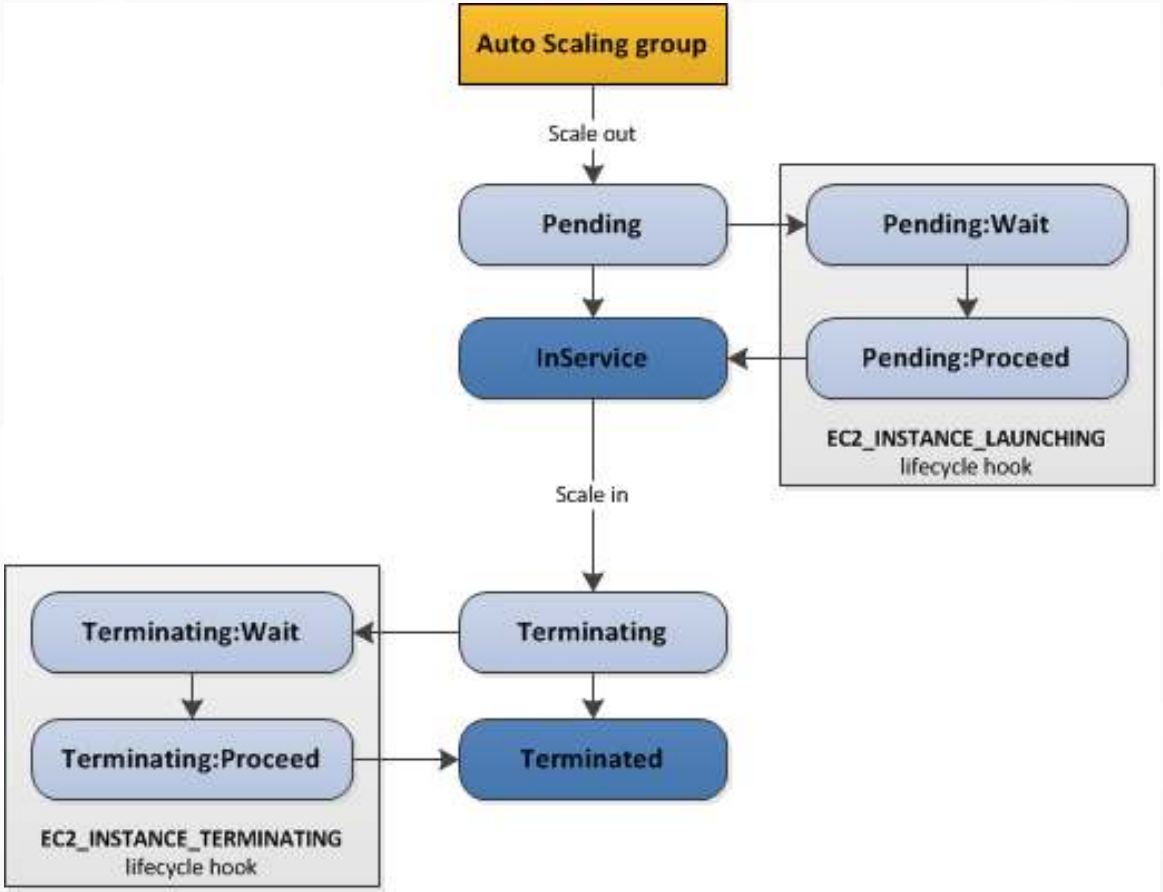
Instance lifecycle



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Lifecycle hook vs notification

Lifecycle hooks

- Executed *before* taking a new instance into service / terminating it
- Put instances into a WAIT state

Auto Scaling SNS notifications

- Notifications get sent *after* an instance has entered “InService” or “Terminated” state, respectively

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Lifecycle hooks with SQS / SNS

1. Create a notification target– either an Amazon **SQS queue,** an Amazon **SNS topic**
2. Create an **IAM role** that allows Auto Scaling to access the notification queue / topic.
3. Associate the lifecycle hook with the Auto Scaling group, role and notification target.
4. Code the lifecycle hook's action

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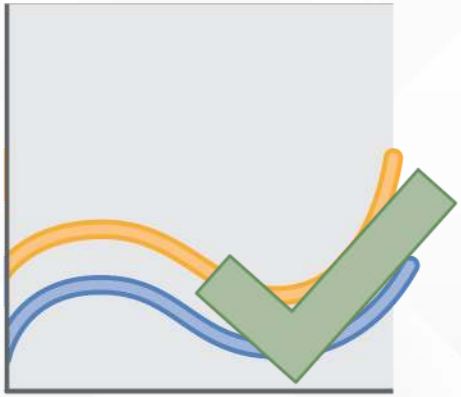
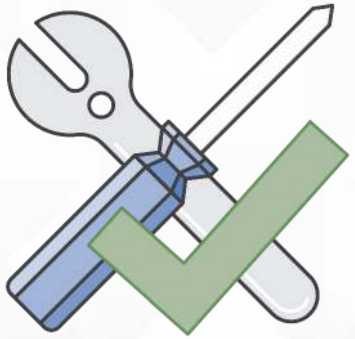
Benefits of Auto Scaling

Elastic:
Automatically adapt capacity to demand



Reliable:
Counteract failures of instances or AZs

Customizable:
With bootstrapping & lifecycle hooks



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DEMO

Demo gods, I'm your humble servant,
please be good to me

Let's look at a new way to implement hooks,
launched in January 2016 : **CloudWatch Events**

Write a Lambda function printing lifecycle events
Create a CloudWatch event rule
Connect it to the Lamba function
Trigger Auto Scaling activity
Fetch events from CloudWatch Logs

…and learn some CLI on the way ;)

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Lifecycle hooks with CloudWatch Events (1)

Write a Lambda function

```
console.log('Loading function');

exports.handler = function(event, context {
    console.log("AutoScalingEvent");
    console.log("Event data:\n" + JSON.stringify(event, null, 4));
    context.succeed("...");
};
```

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Lifecycle hooks with CloudWatch Events (2)

In CloudWatch Events, create a rule to route auto scaling events to your Lambda function

- Select event types
- Select auto scaling groups

Events will be logged to the CloudWatch log group of your Lambda function (created automatically when the function is invoked)

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Event rule

```
{
  "source": [
    "aws.autoscaling"
  ],
  "detail-type": [
    "EC2 Instance Launch Successful",
    "EC2 Instance Terminate Successful",
    "EC2 Instance Launch Unsuccessful",
    "EC2 Instance Terminate Unsuccessful",
    "EC2 Instance-launch Lifecycle Action",
    "EC2 Instance-terminate Lifecycle Action"
  ]
}
```

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Putting it all together

```
% aws lambda get-function --function-name autoscalingFunction
  --query "Configuration.FunctionArn”
% aws events put-rule --name autoscalingRule --event-pattern file://autoscalingRule.json
  --state ENABLED
% aws events put-targets --rule autoscalingRule --targets Id=1,Arn=FUNCTION_ARN
% aws lambda add-permission --function-name autoscalingFunction --statement-id 1
  --action 'lambda:InvokeFunction' --principal events.amazonaws.com --source-arn RULE_ARN

<Start some Auto Scaling activity>

% aws logs describe-log-streams --log-group-name /aws/lambda/autoscalingFunction
  --query "logStreams[].logStreamName”
% aws logs get-log-events --log-stream-name LOG_STREAM_NAME
  --log-group-name /aws/lambda/autoscalingFunction
```

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Thank You

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