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Cloud-Native Runtimes

Inheritance & Polymorphism In Java

Classes, Interfaces, & Records; Oh my!

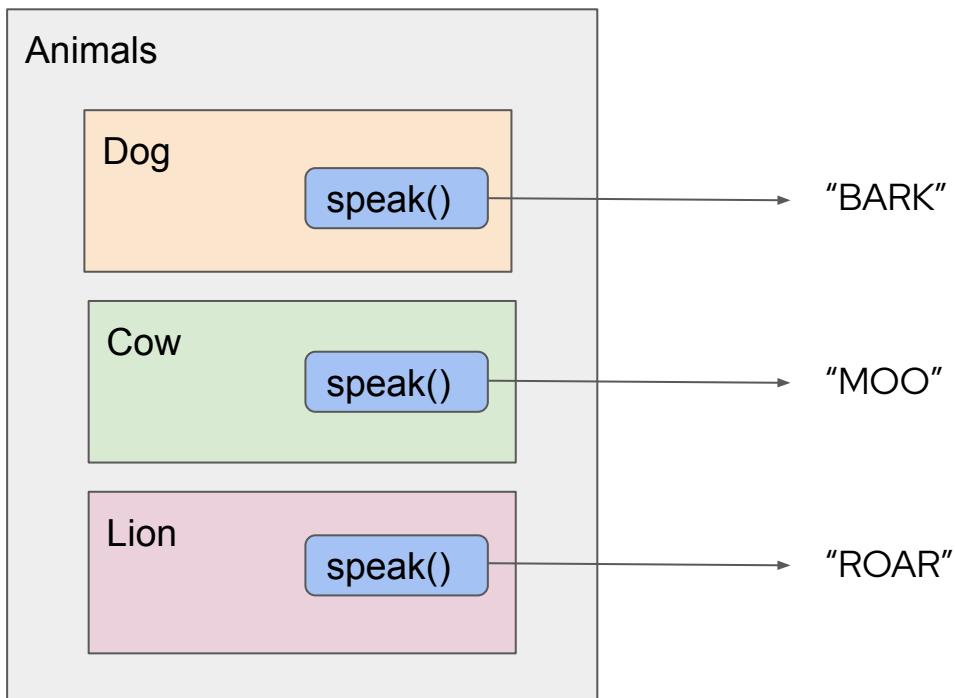
Deven Phillips
Cloud-Native Architect

Definitions



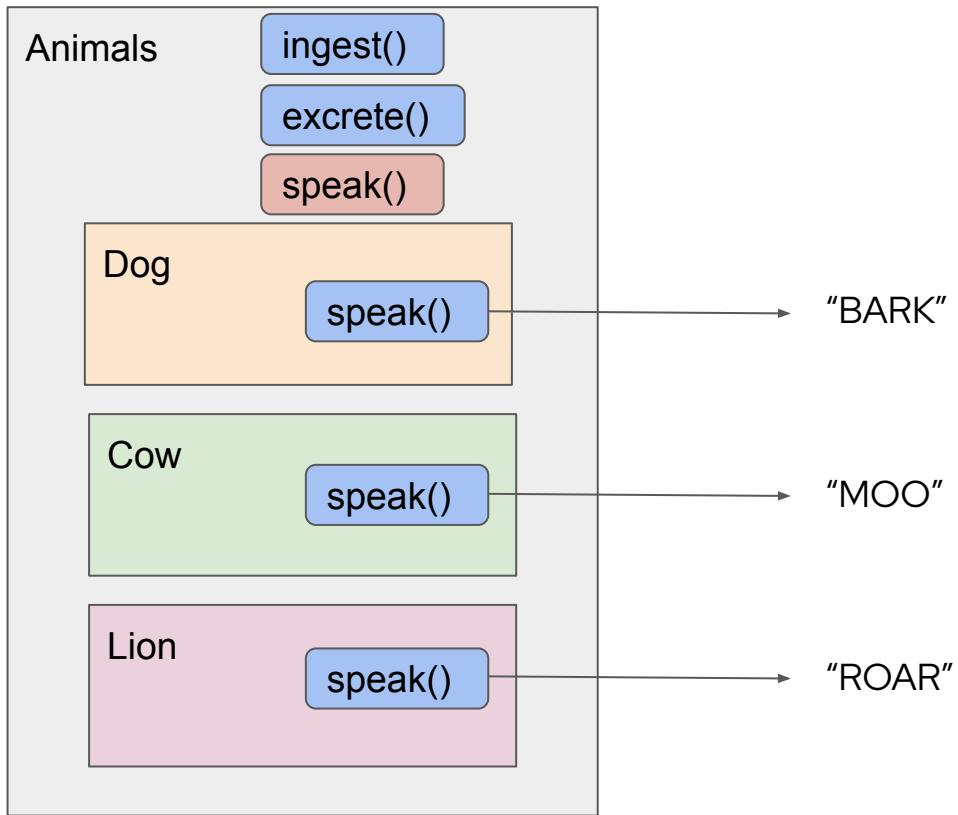
What is Polymorphism?

“Polymorphism--or the ability of an object to execute specialized actions based on its type” - Venkat Subramanian



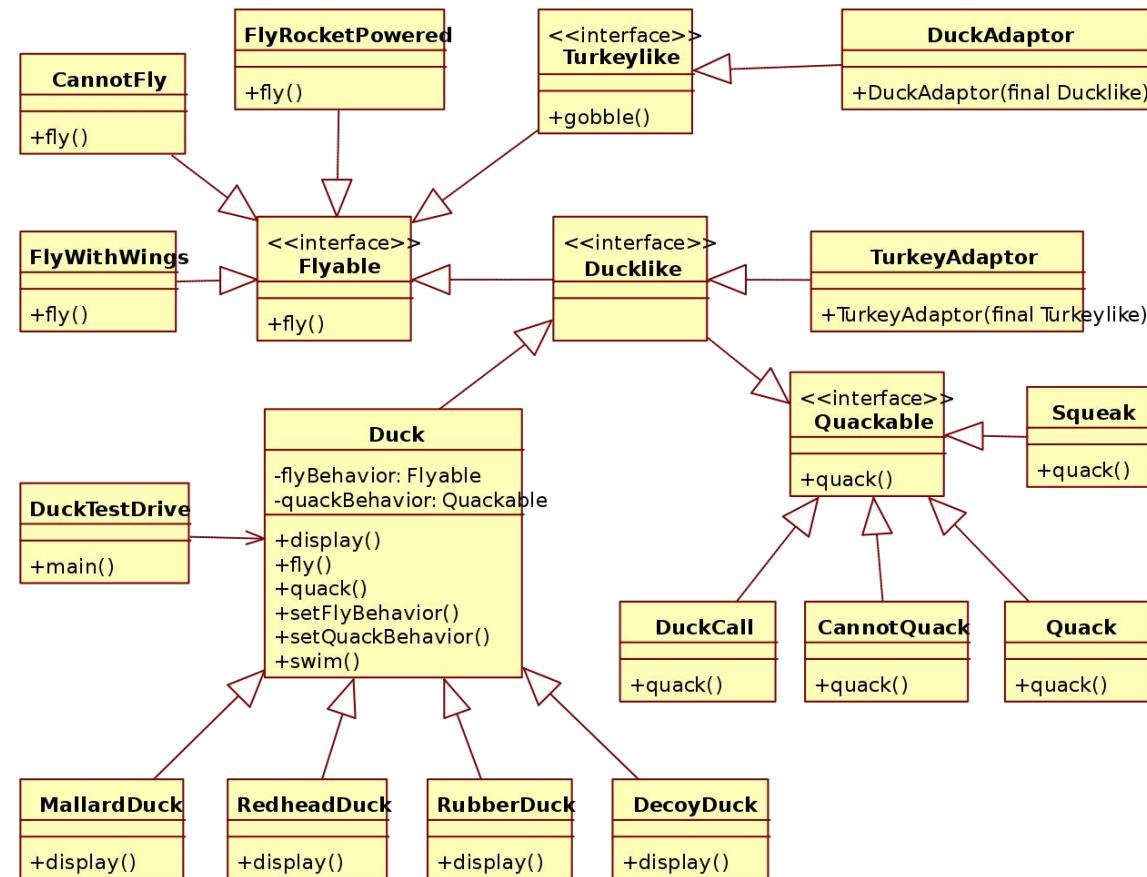
What is Inheritance?

A mechanism where you can derive a class from another class for a hierarchy of classes that share a set of attributes and methods



What is Composition?

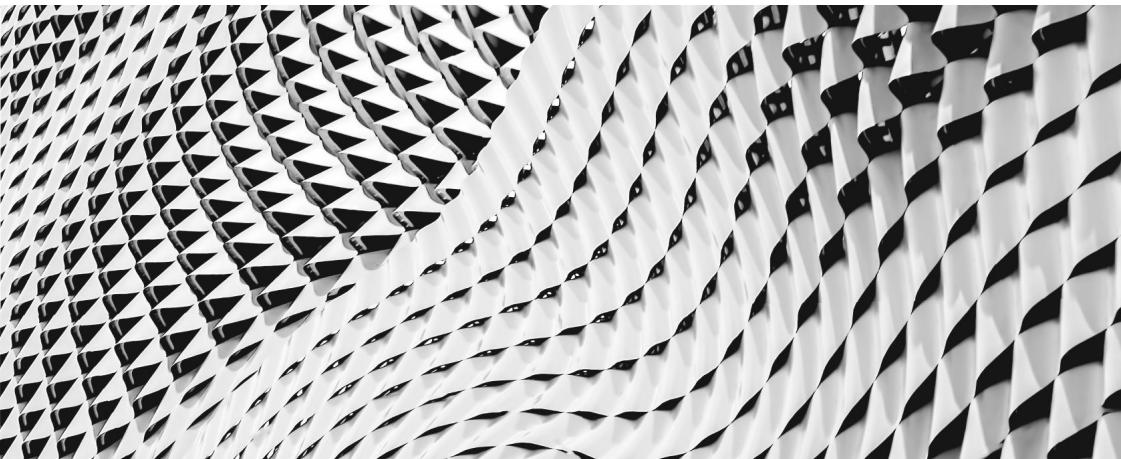
a way to combine objects or data types into more complex ones^[1]



1. https://en.wikipedia.org/wiki/Object_composition

Identifiers Supporting Inheritance or Polymorphism?

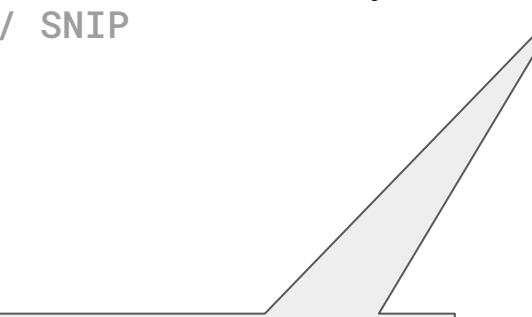
- Class
- Interface
- Record
- Enum



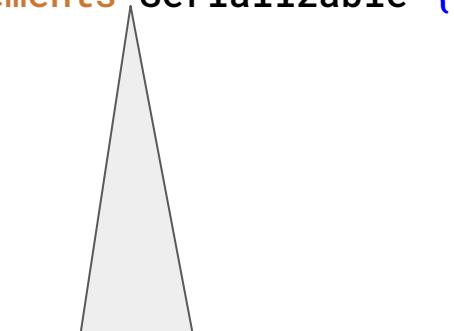
Class

```
package org.juggl.tutorials.inheritance;

public class UserEntity extends AbstractEntity implements Serializable {
    // SNIP
}
```



Pure inheritance. This class inherits all of the fields and methods of AbstractEntity

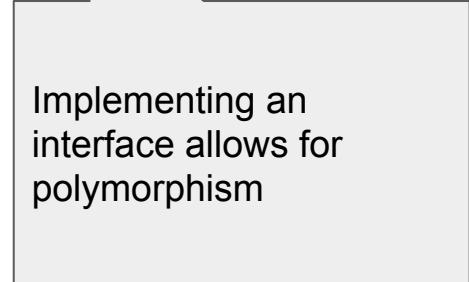


Implementing an interface allows for polymorphism

Abstract Class

```
package org.juggl.tutorials.inheritance;

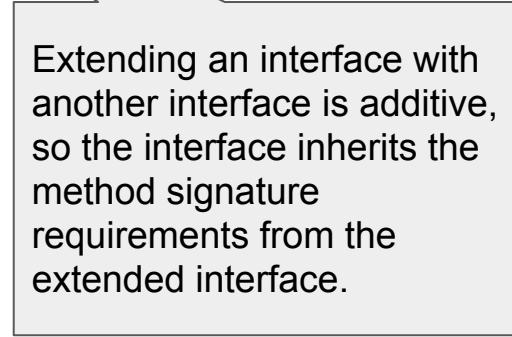
public abstract class AbstractEntity implements EntityContract {
    // SNIP
}
```



Implementing an interface allows for polymorphism

Interface

```
package org.juggl.tutorials.inheritance;  
  
import java.io.Serializable;  
  
public interface EntityContract extends Serializable {  
    // SNIP  
}
```



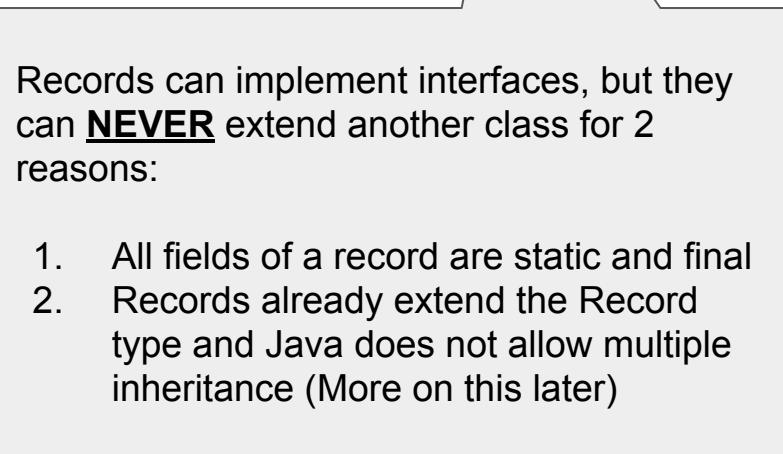
Extending an interface with another interface is additive, so the interface inherits the method signature requirements from the extended interface.

Record

```
package org.juggl.tutorials.inheritance;

import java.io.Serializable;

public record UserRecord(UUID id, String name, String username) implements EntityContract {
    // SNIP
}
```



Records can implement interfaces, but they can **NEVER** extend another class for 2 reasons:

1. All fields of a record are static and final
2. Records already extend the Record type and Java does not allow multiple inheritance (More on this later)

Enums?

```
public interface Verbs {  
    public int getId();  
}
```

```
public enum HttpVerbs implements Verbs {  
    GET    (1),  
    POST   (2),  
    PUT    (3),  
    PATCH  (4),  
    OPTIONS (5),  
    DELETE (6);  
  
    private final int id;  
  
    HttpVerbs(int id) {  
        this.id = id;  
    }  
  
    @Override  
    public int getId() {  
        return id;  
    }  
}
```

While Enums **CAN** implement interfaces as shown here, they cannot extend other classes for much the same reasons that Records cannot extend other classes.

1. All fields of an Enum are static and final
2. Enums already extend the Enum type and Java does not allow multiple inheritance

Practical Applications Of Inheritance & Polymorphism



We have all seen the Animals example, but let's look at some practical examples!

Common Methods Across Controllers

```
public class AbstractController {  
  
    @Autowired  
    private NativeWebRequest request;  
  
    protected String getUsername() {  
        return this.request.getUserPrincipal().getName();  
    }  
}
```

```
@RestController  
public class UserController extends AbstractController {  
  
    @RequestMapping(  
        value = "/user",  
        produces = MediaType.APPLICATION_JSON_VALUE,  
        method = RequestMethod.GET  
    )  
    ResponseEntity<String> getUser() {  
        return ResponseEntity.ok(this.getUsername());  
    }  
}
```

The Repository Pattern

```
public interface UserRepository extends JpaRepository<UserEntity, UUID> {  
  
    @Modifying  
    @Transactional  
    @Query("select from UserEntity where id='1ef5784a-f9dd-11eb-bb38-4ffaa8d8f67f'")  
    UserEntity getDefaultUserId();  
}
```

Multiple Inheritance



But why can I not inherit
from multiple parent
types?

Extending From Two Types Is Not Allowed

```
public class Duck {  
  
    public void layEgg() {  
        System.out.println("Laid an egg");  
    }  
  
    public void speak() {  
        System.out.println("Quack");  
    }  
}
```

```
public class Mammal {  
  
    public void lactate() {  
        System.out.println("Lactating");  
    }  
  
    public void speak() {  
        System.out.println("Squeak");  
    }  
}
```

```
public class Platypus extends Duck, Mammal {  
}
```

And here lies the main issue with multiple inheritance. What do we do as language designers when two parent classes have conflicting methods? Or worse, the conflicting methods are somewhere higher up in the inheritance hierarchy? It just becomes too difficult to implement something that “just works”.

There is a workaround, BUT...

```
public interface Duck {  
  
    default void layEgg() {  
        System.out.println("Laid an egg");  
    }  
  
    default void speak() {  
        System.out.println("Quack");  
    }  
}
```

```
public interface Mammal {  
  
    default void lactate() {  
        System.out.println("Lactating");  
    }  
  
    default void squeak() {  
        System.out.println("Squeak");  
    }  
}
```

```
public class Platypus implements Duck, Mammal {  
    @Override  
    public void speak() {  
        Duck.super.speak();  
    }  
}
```

DO NOT DO THIS!!!

Best Practices



Prefer Composition Over Inheritance

```
public interface Animal {  
    public void ingest();  
    public void excrete();  
}
```

```
public interface Mammal extends Animal {  
    public void lactate();  
}
```

```
public interface Bird extends Animal {  
    public void molt();  
}
```

```
public interface Nester {  
    public void buildNest();  
    public void raiseBrood();  
}
```

```
public interface Swimmer {  
    public void swim();  
}
```

```
public interface Reptile extends Animal {  
    public void shedSkin();  
}
```

```
public class Platypus implements Mammal, Nester, Swimmer {  
    // SNIP  
}  
  
public class Aligator implements Reptile, Nester, Swimmer {  
    // SNIP  
}  
  
public class Finch implements Bird, Nester {  
    // SNIP  
}
```

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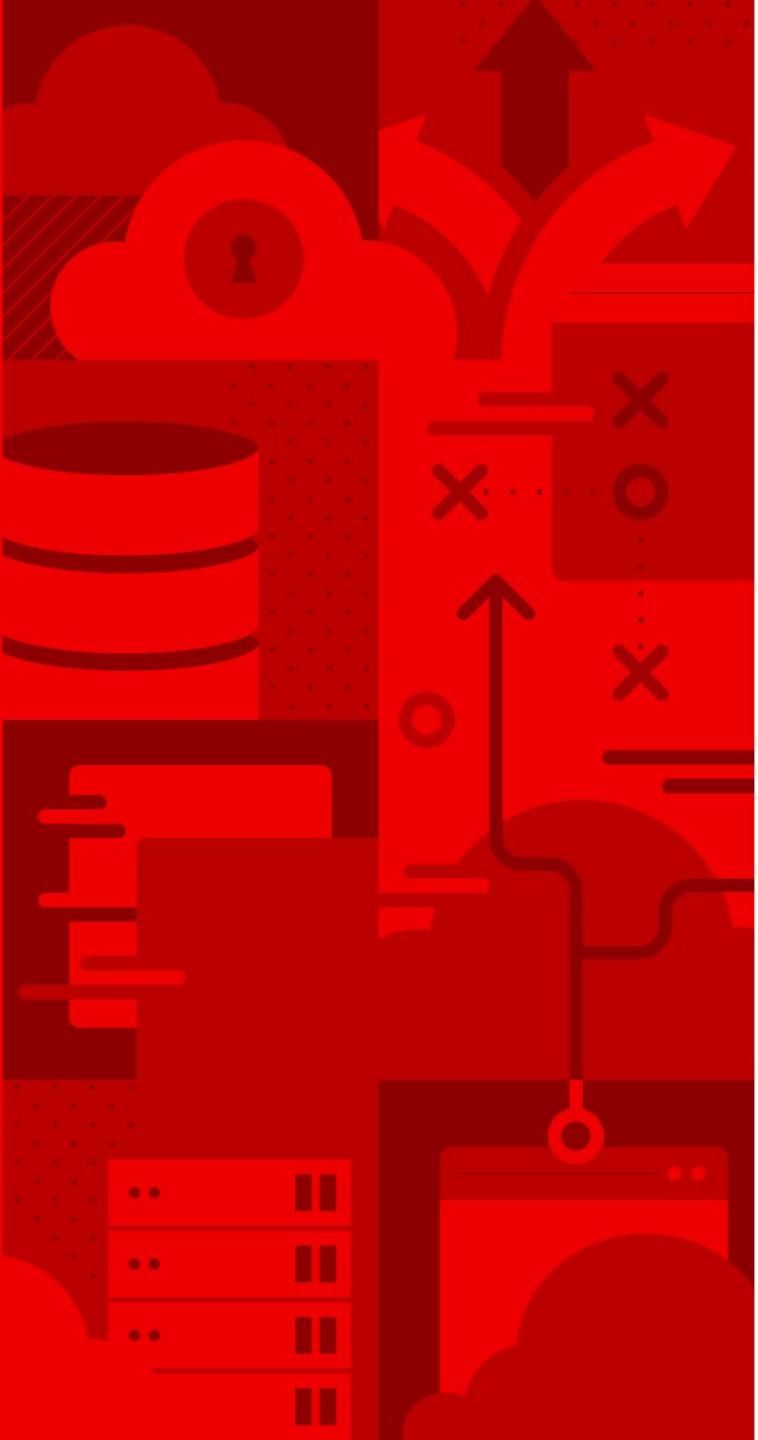


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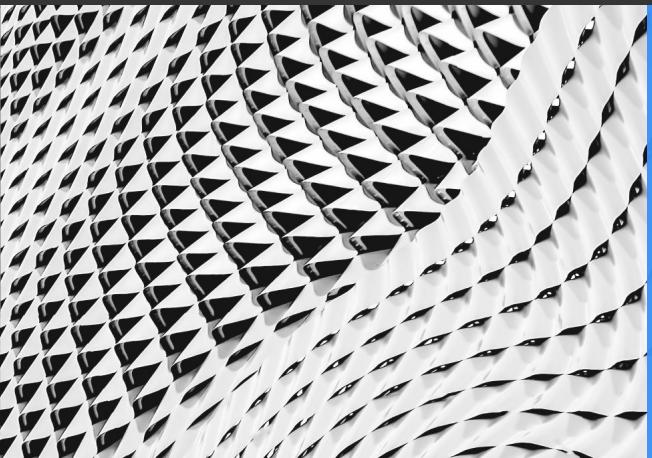
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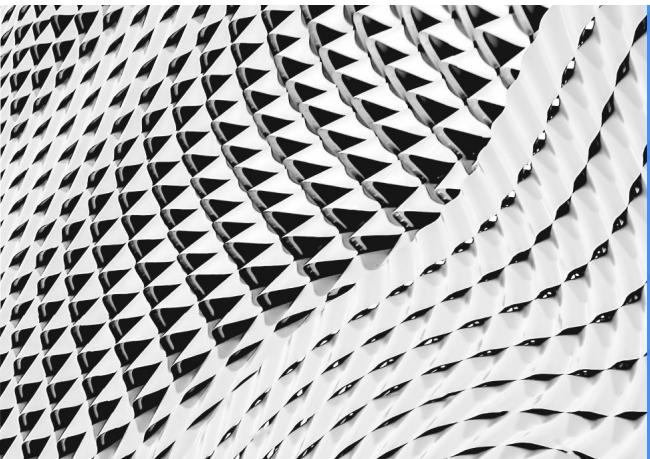
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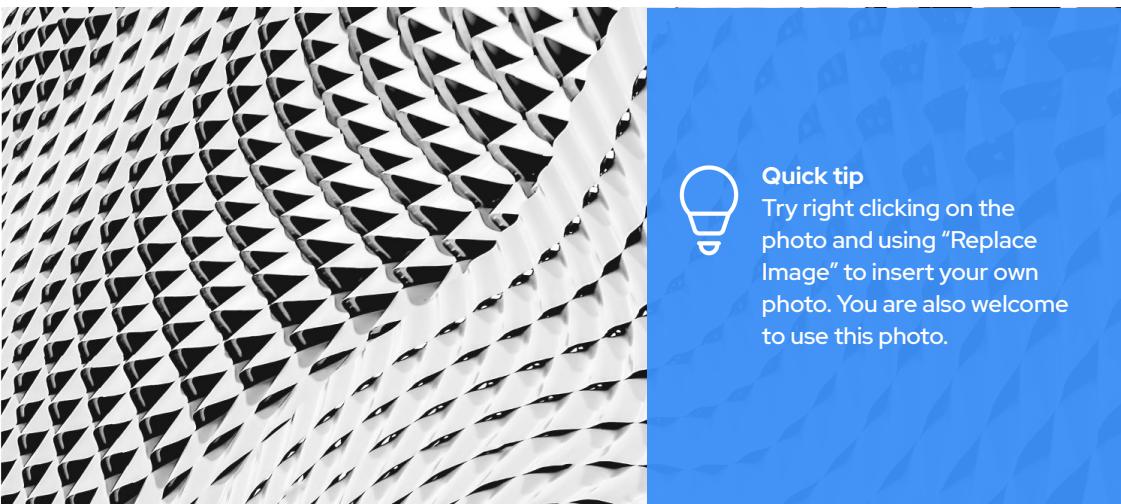
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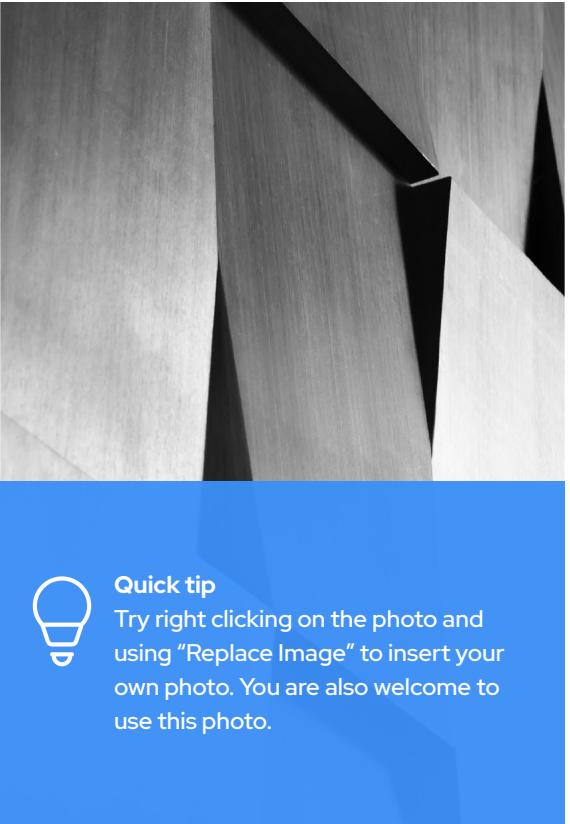


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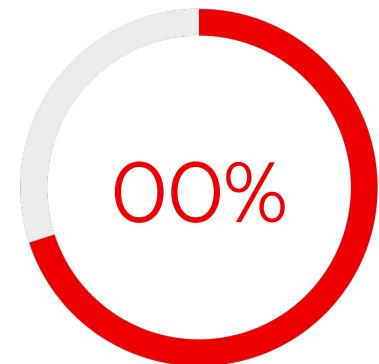
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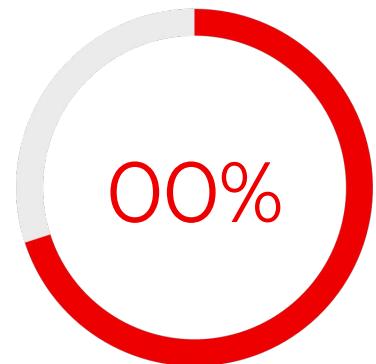
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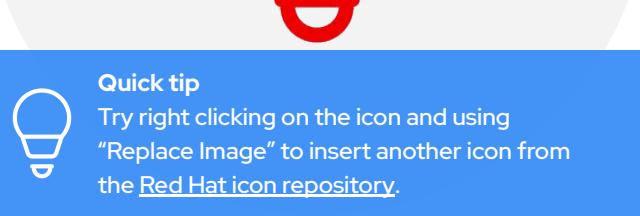
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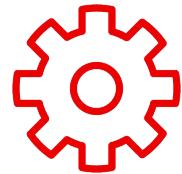


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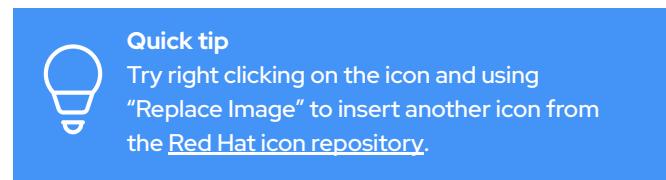
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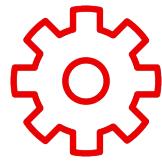


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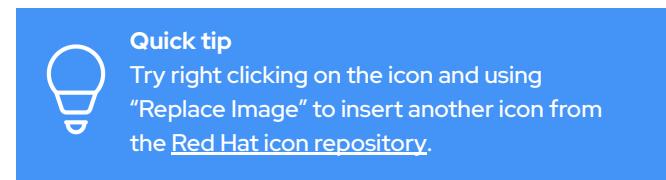
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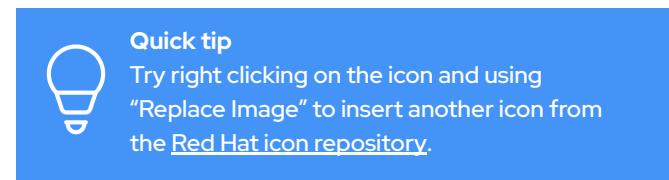
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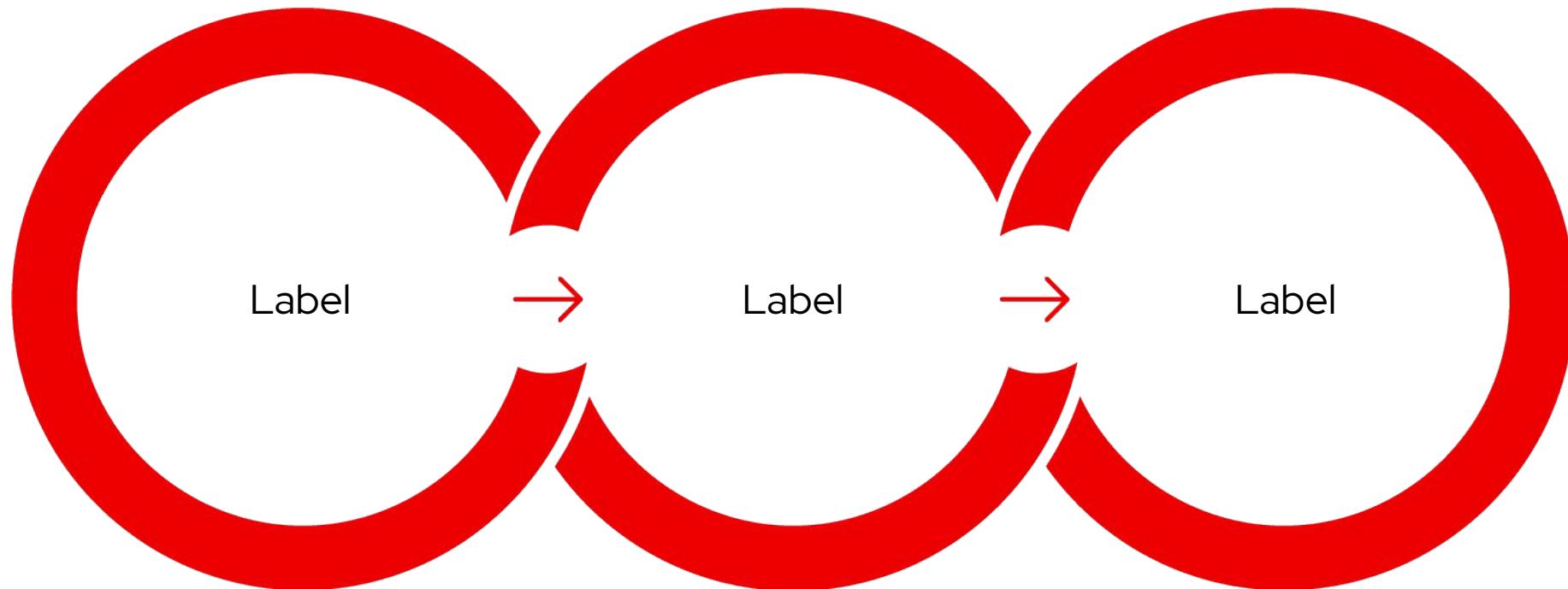
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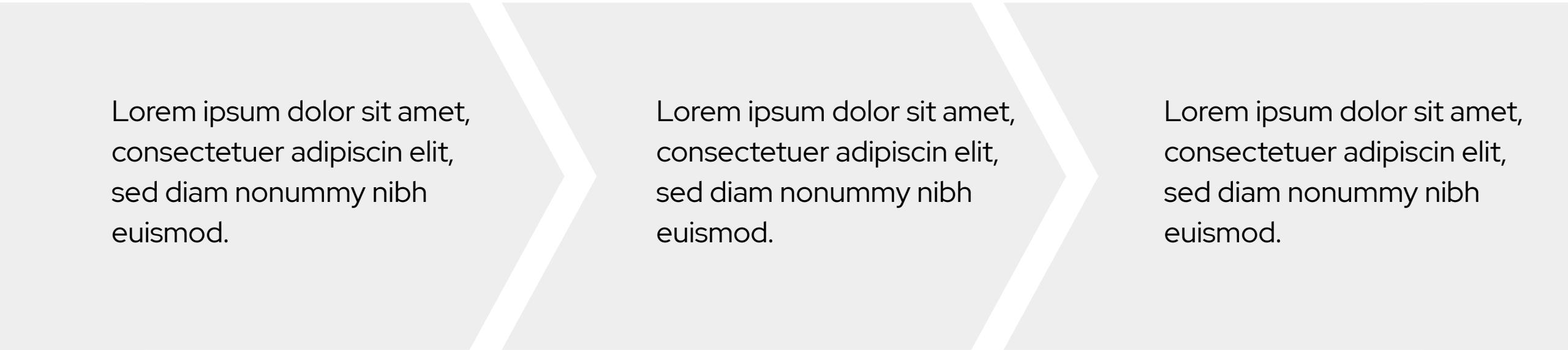
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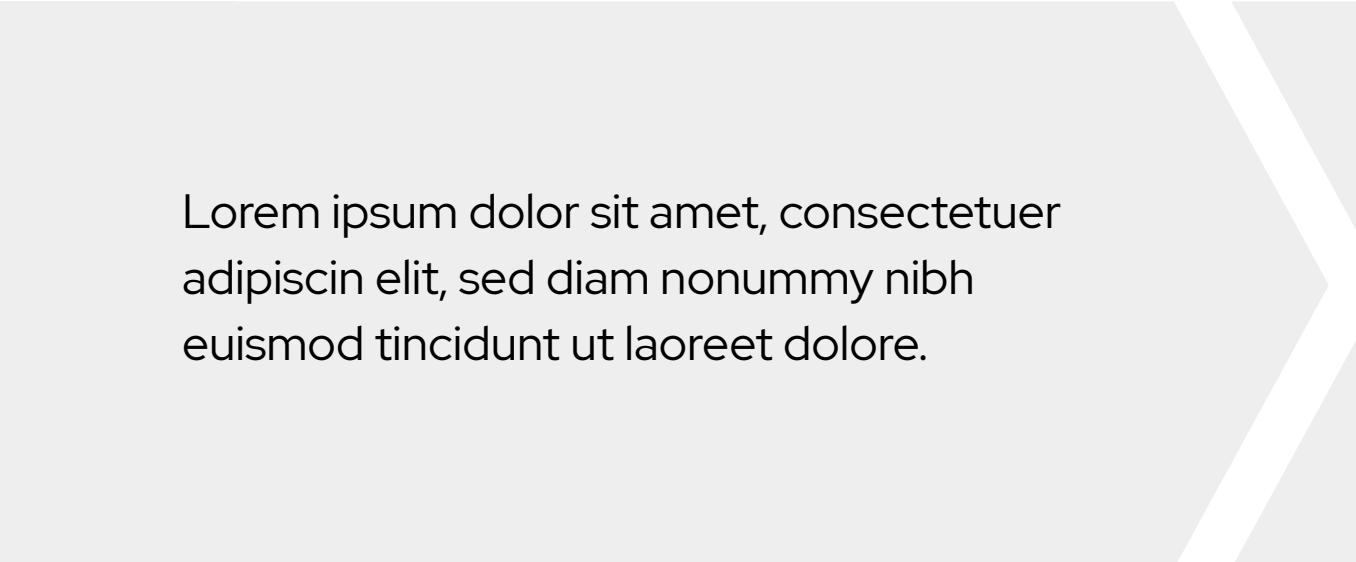
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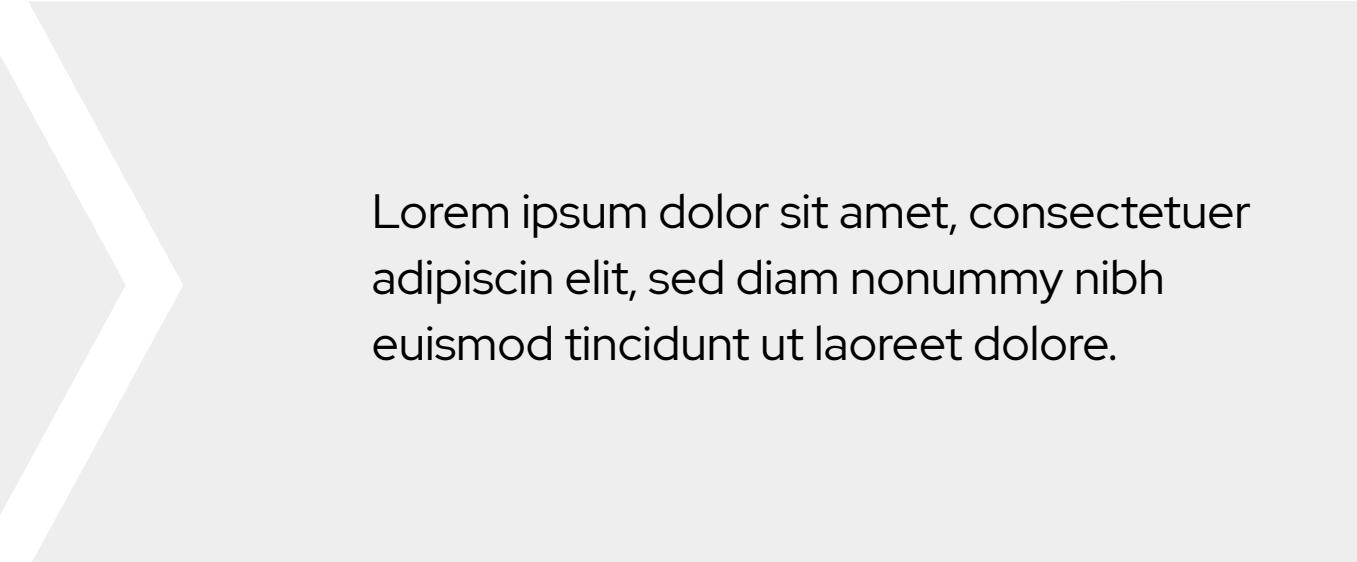
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Table slide templates

Timeline templates



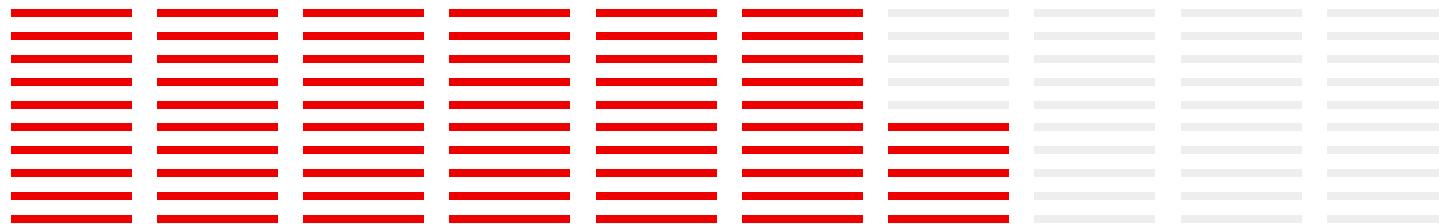
Template slide

Click on this slide's thumbnail to the left and delete from your presentation before use.

Optional section marker or title

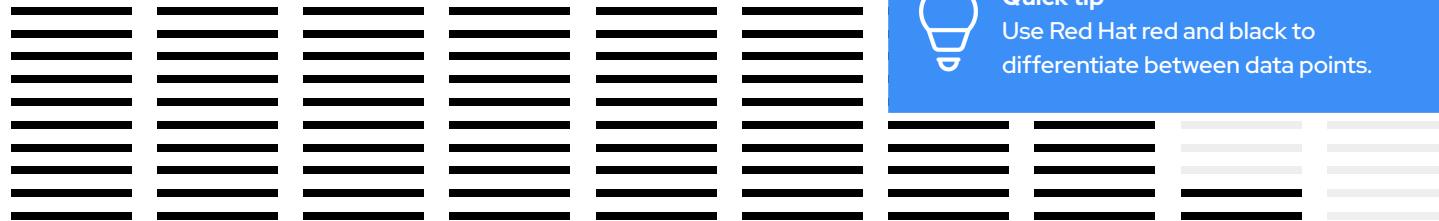
Slide title should not exceed one line

Optional subheading



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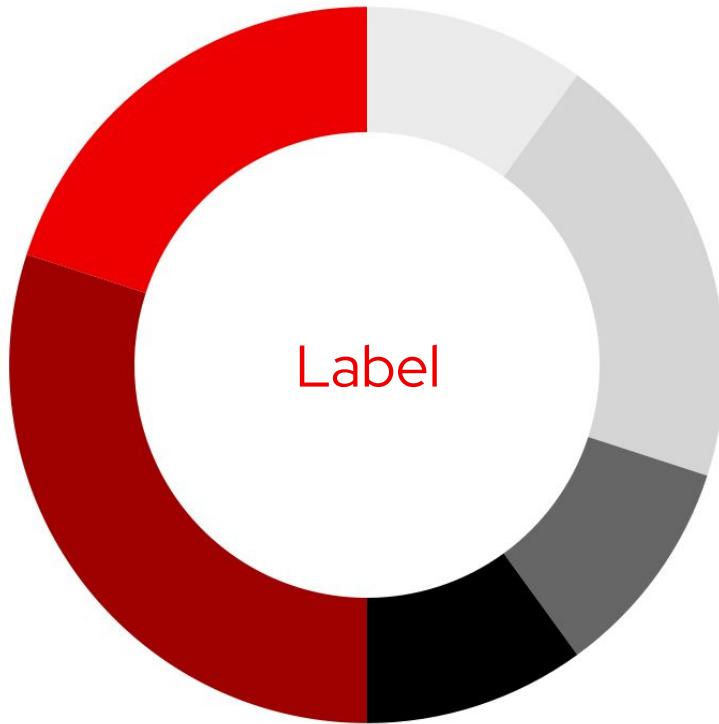


Quick tip
Use Red Hat red and black to differentiate between data points.

Slide title should not exceed one line

Optional subheading

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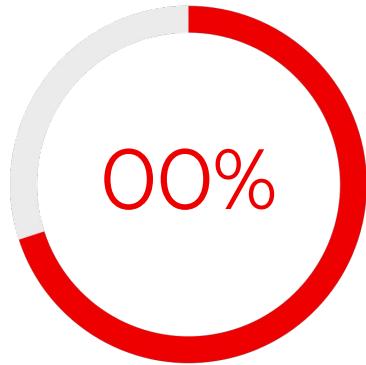
Quick tip

To edit a chart, select it and click the dropdown arrow in the top right.
Select "Open source." The legend will need to be updated manually.

Optional section marker or title

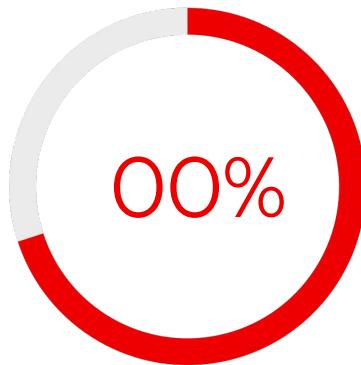
Slide title should not exceed one line

Optional subheading



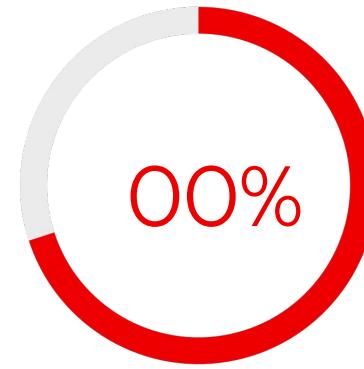
Body headline

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Body headline

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Quick tip

To edit a chart, select it and click the dropdown arrow in the top right.
Select "Open source." The percentage will need to be updated manually.

Slide title should not exceed one line

Optional subheading

Three red-outlined circles are arranged horizontally, centered on the page.

Body headline

Lorem ipsum dolor sit amet,
 consectetuer adipiscing elit, sed diam
 nonummy nibh euismod.

Three large, hollow circles with thick red outlines, arranged horizontally. They are positioned at the top of the page, centered horizontally.

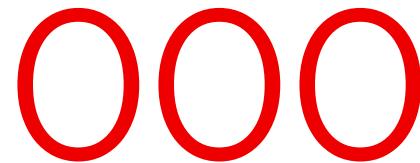
Body headline

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Optional section marker or title

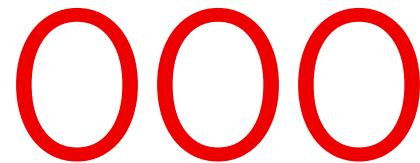
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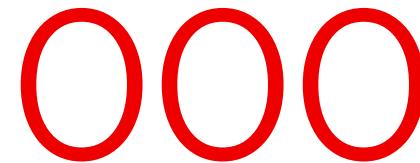
Body headline

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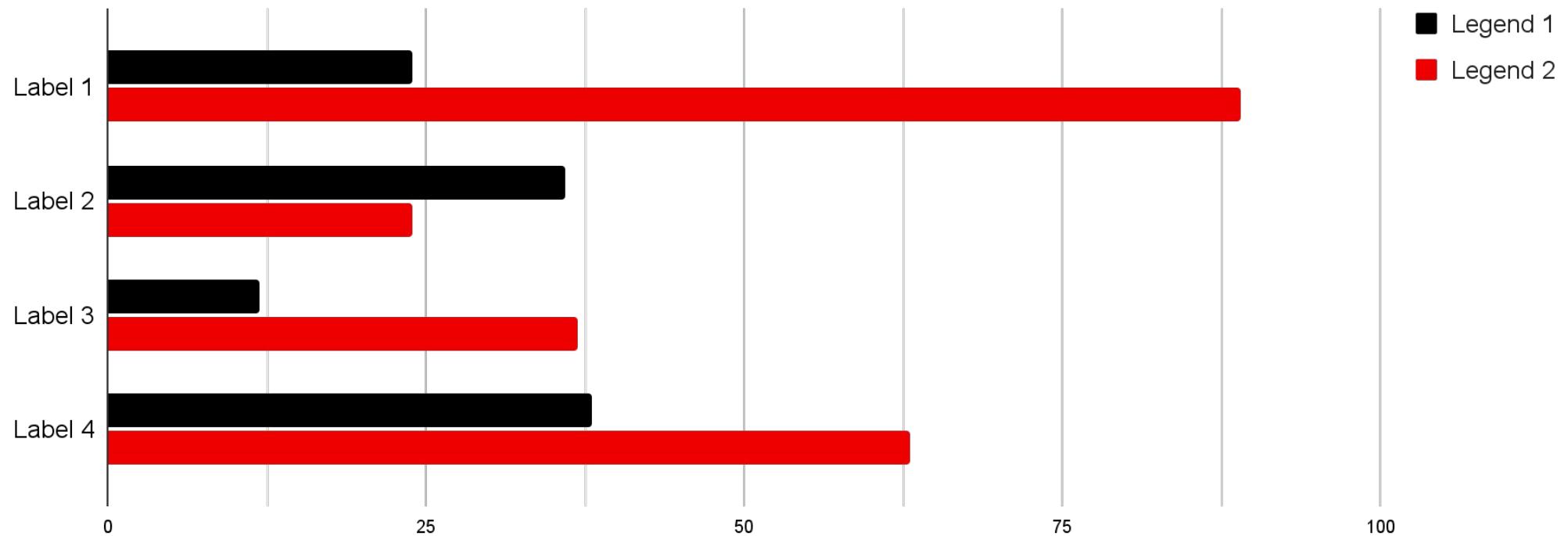
Body headline

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Slide title should not exceed one line

Optional subheading

Chart title



Quick tip

To edit a chart, select it and click the dropdown arrow in the top right. Select "Open source."

Optional section marker or title

Slide title should not exceed one line

Optional subheading



Quick tip

Use the "Width Scale" in the "Size & Position" pane of the format options panel to adjust the percentage of the bar.

Optional section marker or title

Slide title should not exceed
three lines Lorem ipsum dolor
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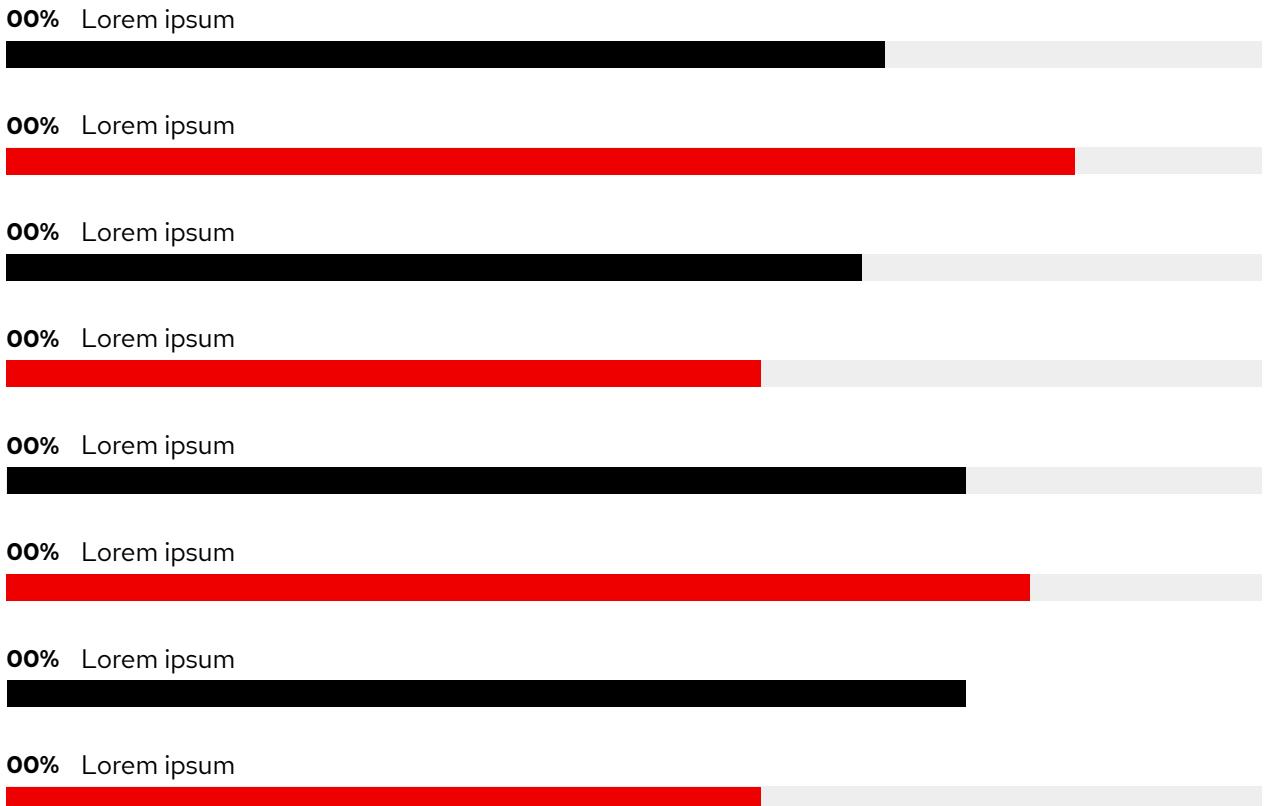
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Source:
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Quick tip

Use the "Width Scale" in the "Size & Position" pane of the format options panel to adjust the percentage of the bar.

Slide title should not exceed
three lines Lorem ipsum dolor
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Optional subheading should not
exceed three lines Lorem ipsum
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01 Title of table

	Column header two lines maximum	Column header two lines maximum	Column header two lines maximum
Row header with two lines maximum	Body cell should be limited to two lines	Body cell should be limited to two lines	Body cell should be limited to two lines
Row header with two lines maximum	Body cell should be limited to two lines	Body cell should be limited to two lines	Body cell should be limited to two lines
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Row header with two lines maximum	Body cell should be limited to two lines	Body cell should be limited to two lines	Body cell should be limited to two lines

Slide title should not exceed one line

Optional subheading

01 Title of table

| | Column header
two lines maximum |
|--------------------------------------|---|---|---|---|---|
| Row header with
two lines maximum | Body cell should be
limited to two lines |
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| Row header with
two lines maximum | Body cell should be
limited to two lines |

Optional section marker or title

Slide title should not exceed one line

Optional subheading

Body headline

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Body headline

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Body headline

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Quick tip

Try right clicking on the photo and using “Replace Image” to insert your own photo. You are also welcome to use this photo.



Heading



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Heading

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Quick tip

Try right clicking on the photo and using "Replace Image" to insert your own photo. You are also welcome to use this photo.



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Heading

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Quick tip

Try right clicking on the photo and using "Replace Image" to insert your own photo. You are also welcome to use this photo.

This section includes:

Dark theme slide templates



Template slide

Click on this slide's thumbnail to the left and delete from your presentation before use.

**Quick tip**

If the presentation is not product focused, simply delete this. Do NOT insert the Red Hat logo here. If this is a product-focused deck, right click on the logo and using "Replace Image" insert the product logo of your choice. After replacing the image, right click and select "Reset Image". Adjust spacing as needed.

Presentation title should not exceed two lines

Optional subheading

Presenter's Name

Title

Presenter's Name

Title

Thank you

Red Hat is the world's leading provider of enterprise open source software solutions. Award-winning support, training, and consulting services make Red Hat a trusted adviser to the Fortune 500.



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youtube.com/user/RedHatVideos



facebook.com/redhatinc



twitter.com/RedHat

Optional section marker or title



Title should not exceed two lines

Optional subheading

Presenter's Name

Title



Thank you

Red Hat is the world's leading provider of enterprise open source software solutions. Award-winning support, training, and consulting services make Red Hat a trusted adviser to the Fortune 500.



[linkedin.com/company/red-hat](https://www.linkedin.com/company/red-hat)



[facebook.com/redhatinc](https://www.facebook.com/redhatinc)



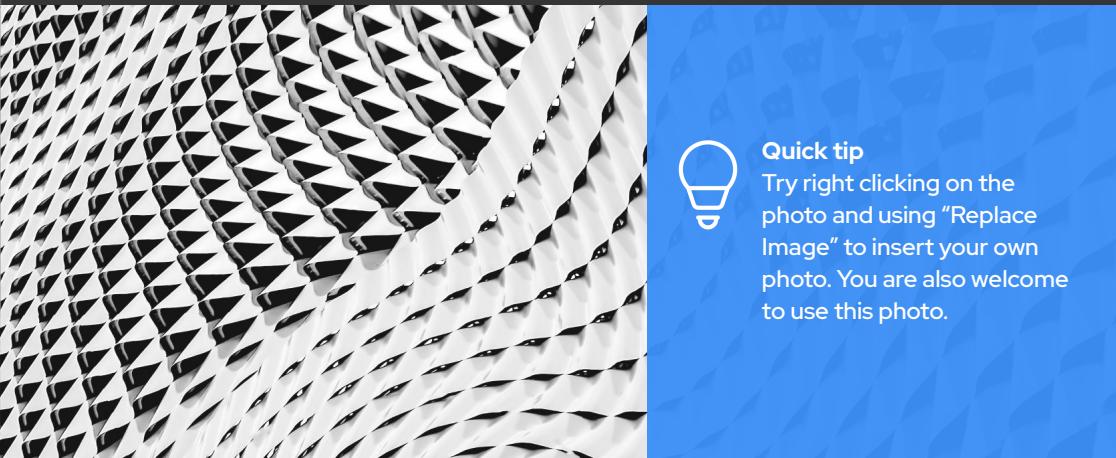
[youtube.com/user/RedHatVideos](https://www.youtube.com/user/RedHatVideos)



twitter.com/RedHat

Divider title limit to two lines

Optional supporting copy.
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Quick tip

Try right clicking on the photo and using “Replace Image” to insert your own photo. You are also welcome to use this photo.

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This section includes:

Topic

Topic

Topic

Topic

Slide title should not exceed one line

Optional subheading

Quick tip

Insert image in this designated area, deleting the shaded background. Keep the left and right margins clear to maintain the open feel in accordance with the brand.
If no subheading is needed, delete the subheading text, and the content can extend into the lighter shaded area.

Quick tip

Insert image in this designated area, deleting the shaded background. Keep the left, right, top, and bottom margins clear to maintain the open feel in accordance with the brand.

Quick tip

Insert image in this designated area, deleting the shaded background. Keep the left, right, top, and bottom margins clear to maintain the open feel in accordance with the brand.

Optional subheading

Optional supporting copy.
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Optional subheading

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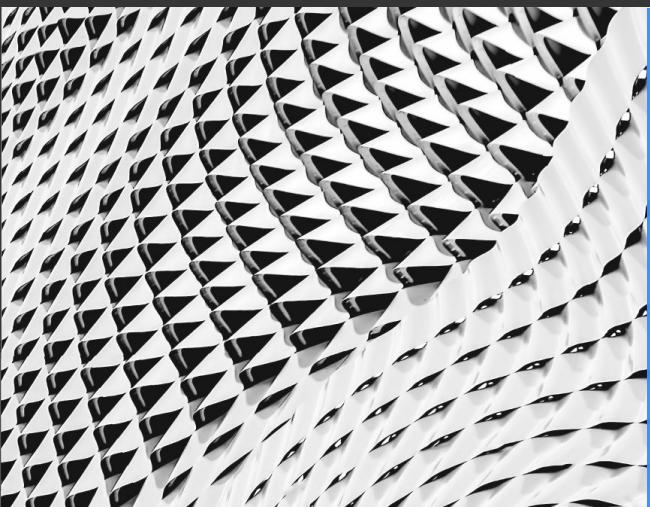
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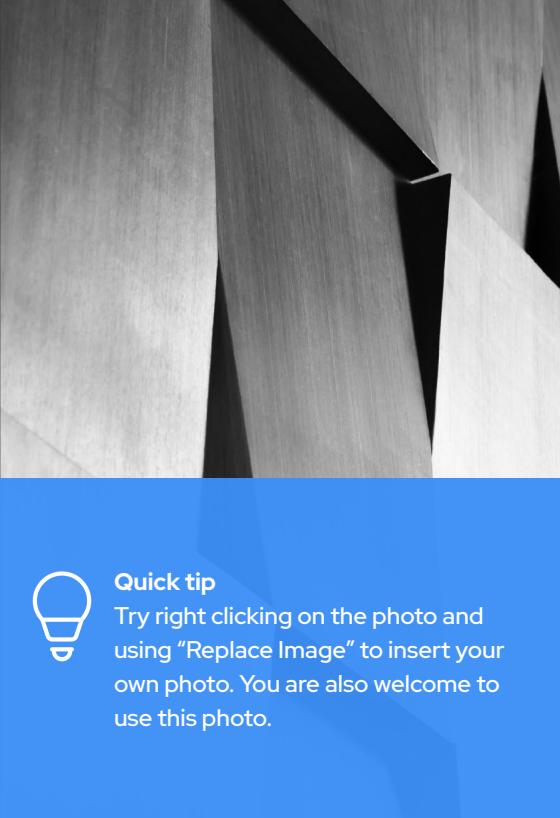
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Quick tip

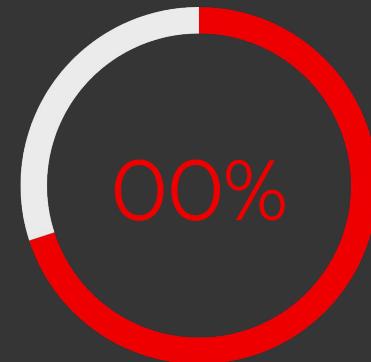
Try right clicking on the photo and using "Replace Image" to insert your own photo. You are also welcome to use this photo.

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Slide title should not exceed one line

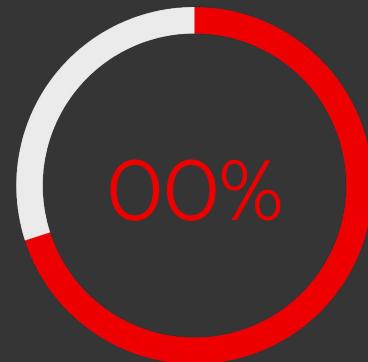
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Body headline

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Body headline

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Quick tip

To edit a chart, select it and click the dropdown arrow in the top right.
Select "Open source." The percentage will need to be updated manually.

Slide title should not exceed one line

Optional subheading

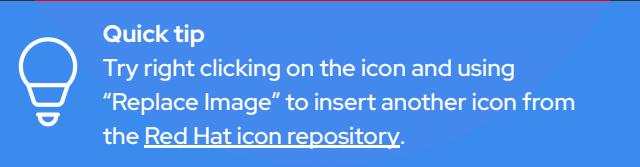
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 **Quick tip**
Try right clicking on the photo and using "Replace Image" to insert your own photo. You are also welcome to use this photo.

Slide title should not exceed one line

Optional subheading



Body headline

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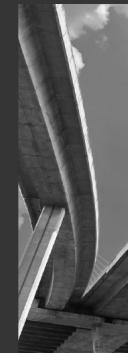
Body headline

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Body headline

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Quick tip
Try right clicking on the
photo and using
“Replace Image” to
insert your own photo.
You are also welcome
to use this photo.

Body headline

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Slide title should not exceed one line

Optional subheading



Body headline

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Body headline

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Quick tip

Try right clicking on the icon and using
“Replace Image” to insert another icon from
the [Red Hat icon repository](#).

Slide title should not exceed two lines

Optional subheading should not exceed three lines
Lorem ipsum dolor sit amet consectetur



Body headline

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 Quick tip
Try right clicking on the icon and using "Replace Image" to insert another icon from the [Red Hat icon repository](#).

Slide title should not exceed one line

Optional subheading



Body headline

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Body headline

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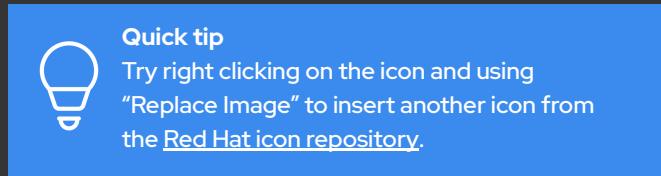
Body headline

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Slide title should not exceed one line

Optional subheading



Body headline

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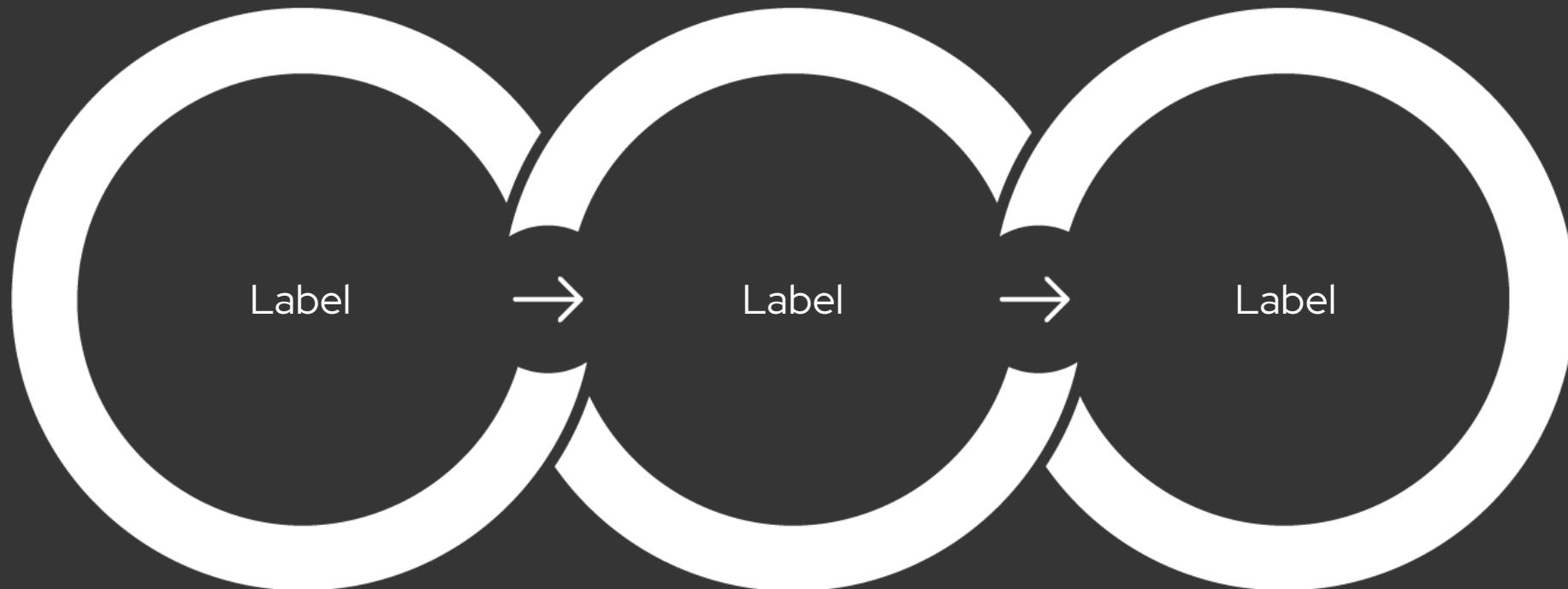


Quick tip

Try right clicking on the icon and using
“Replace Image” to insert another icon from
the [Red Hat icon repository](#).

Slide title should not exceed one line

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Slide title should not exceed one line

Optional subheading

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Optional subheading

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**Quick tip**

Using a photo with the large quote is optional. Try right clicking on the photo and using "Replace Image" to insert your own photo.

"Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis id auctor dui. Ut neque sem, convallis sit amet ultrices et, facilisis vestibulum ligula. Donec euismod elementum erat vitae fermentum. Mauris hendrerit maximus bibendum."

John Doe

CTO, Acme Unlimited

Slide title should not exceed one line

Optional subheading



“Lorem ipsum dolor sit amet, consectetuer
adipis elit, sed diam nonummy nibh
euismod tincidunt ut laoreet dolore magna
aliquam erat volutpat.”

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John Doe

CTO, Acme Unlimited



“Lorem ipsum dolor sit amet, consectetuer
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John Doe

CTO, Acme Unlimited

Slide title should not exceed one line

Optional subheading



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John Doe

CTO, Acme Unlimited



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John Doe

CTO, Acme Unlimited



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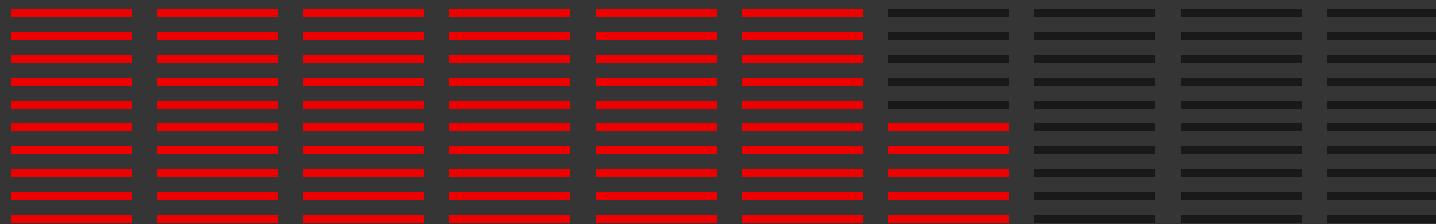
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John Doe

CTO, Acme Unlimited

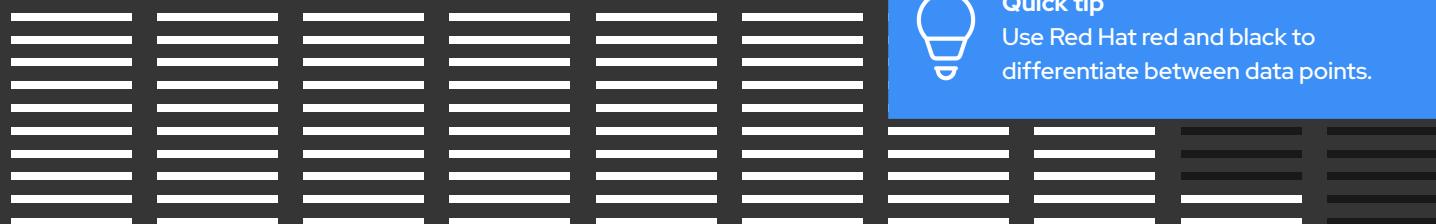
Slide title should not exceed one line

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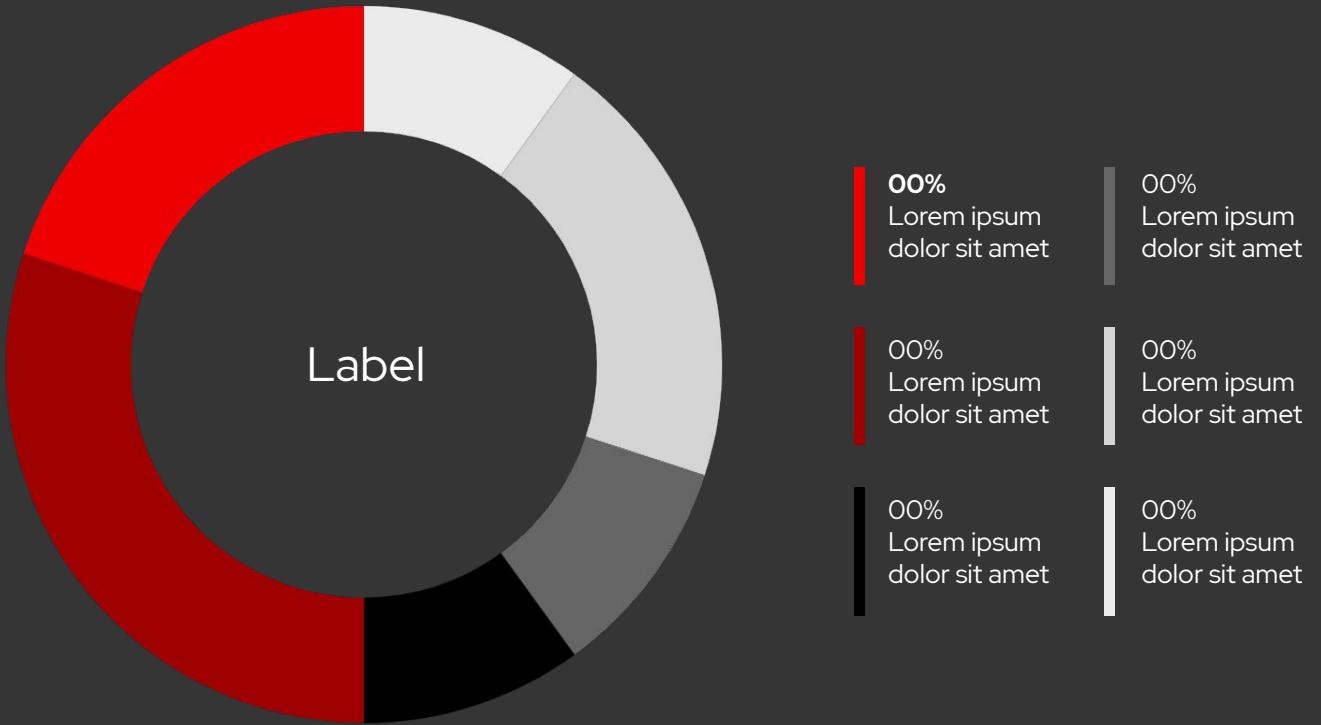


Quick tip
Use Red Hat red and black to differentiate between data points.

Slide title should not exceed one line

Optional subheading

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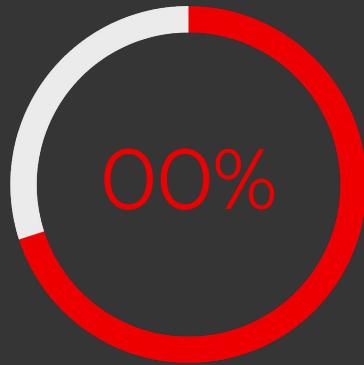


Quick tip

To edit a chart, select it and click the dropdown arrow in the top right.
Select "Open source." The legend will need to be updated manually.

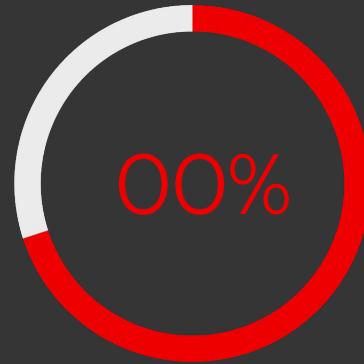
Slide title should not exceed one line

Optional subheading



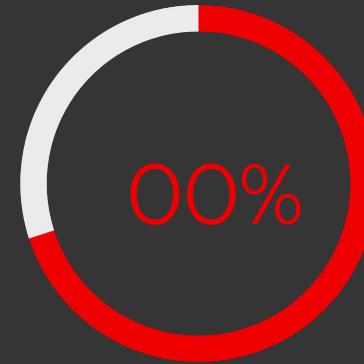
Body headline

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Body headline

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Quick tip

To edit a chart, select it and click the dropdown arrow in the top right.
Select "Open source." The percentage will need to be updated manually.

Slide title should not exceed one line

Optional subheading

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Body headline

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Slide title should not exceed one line

Optional subheading



Body headline

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Body headline

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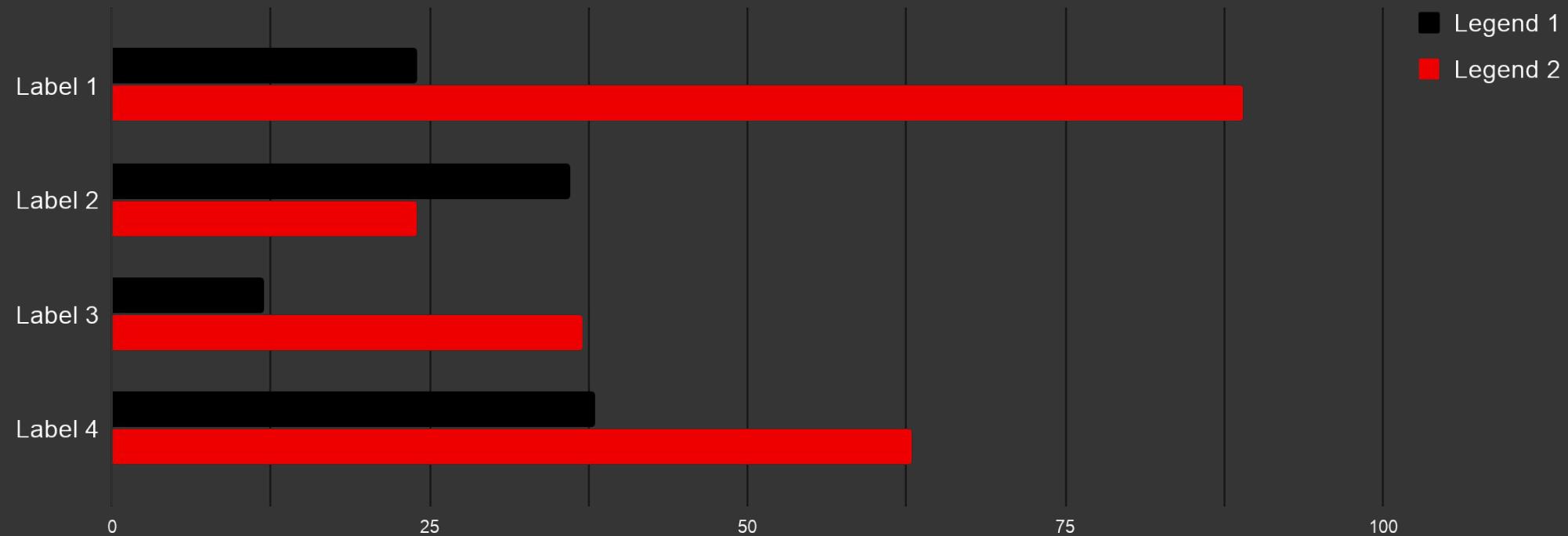
Body headline

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Slide title should not exceed one line

Optional subheading

Chart title



Quick tip

To edit a chart, select it and click the dropdown arrow in the top right. Select "Open source."

Slide title should not exceed one line

Optional subheading



Quick tip

Use the "Width Scale" in the "Size & Position" pane of the format options panel to adjust the percentage of the bar.

Slide title should not exceed two lines

Optional subheading should not exceed three lines
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01 Title of chart



Quick tip

Use the "Width Scale" in the "Size & Position" pane of the format options panel to adjust the percentage of the bar.

Slide title should not exceed two lines

Optional subheading should not exceed three lines
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01 Title of table

Column header two lines maximum	Column header two lines maximum	Column header two lines maximum
Row header with two lines maximum	Body cell should be limited to two lines	Body cell should be limited to two lines
Row header with two lines maximum	Body cell should be limited to two lines	Body cell should be limited to two lines
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Row header with two lines maximum	Body cell should be limited to two lines	Body cell should be limited to two lines

Slide title should not exceed one line

Optional subheading

01 Title of table

| | Column header
two lines maximum |
|--------------------------------------|---|---|---|---|---|
| Row header with
two lines maximum | Body cell should be
limited to two lines |
| Row header with
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| Row header with
two lines maximum | Body cell should be
limited to two lines |

Slide title should not exceed one line

Optional subheading

Body headline

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consectetuer adipiscing elit,
diam nonummy nibh euismod.

Body headline

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Body headline

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Quick tip

Try right clicking on the photo and using "Replace Image" to insert your own photo. You are also welcome to use this photo.



Heading

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