



# Data Visualisation with R

Workshop Part 1

🔑 Why grammar of graphics  
for data visualisation?

# Constructing plots with R: base version

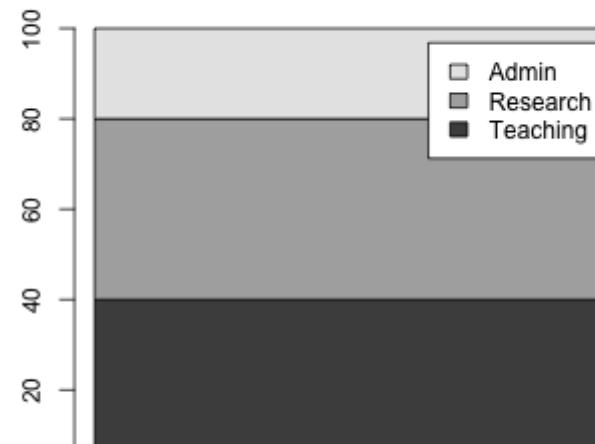
df

```
## # A tibble: 3 × 2
##   duty      perc
##   <chr>     <dbl>
## 1 Teaching    40
## 2 Research    40
## 3 Admin       20
```

▶ ggplot2 version

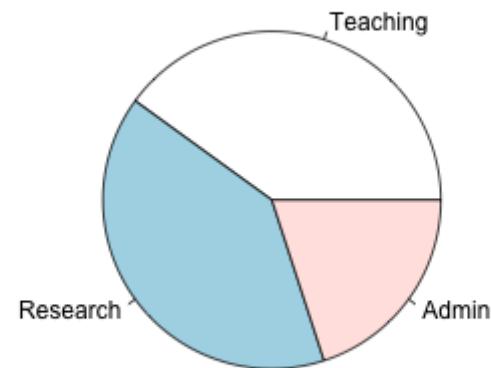
## Stacked barplot

```
barplot(as.matrix(df$perc),
        legend = df$duty)
```



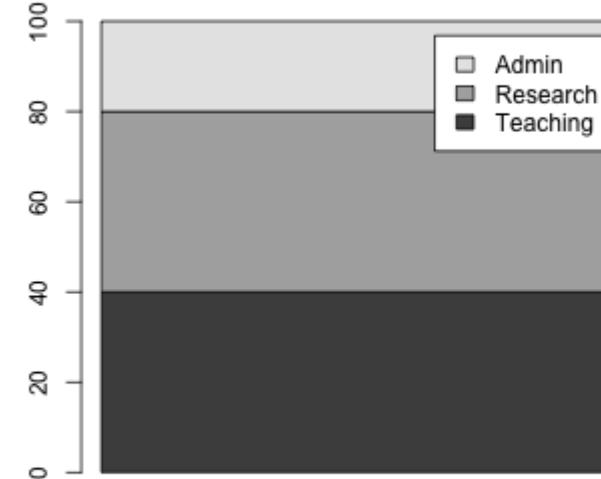
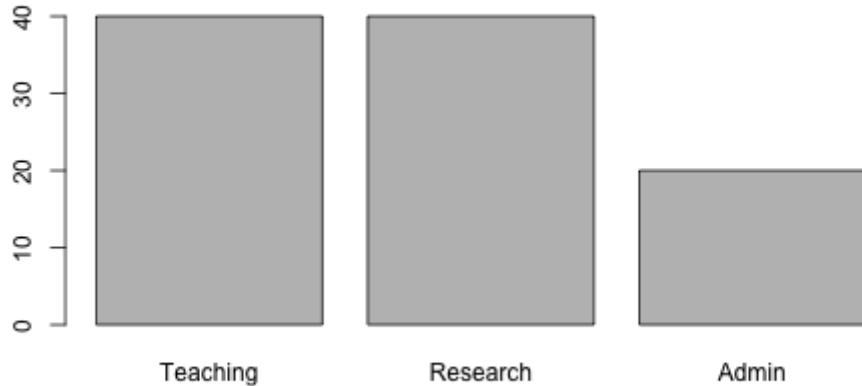
## Pie chart

```
pie(df$perc, labels = df$duty)
```



- Single purpose functions to generate "named plots"
- Input varies, here it is vector or matrix

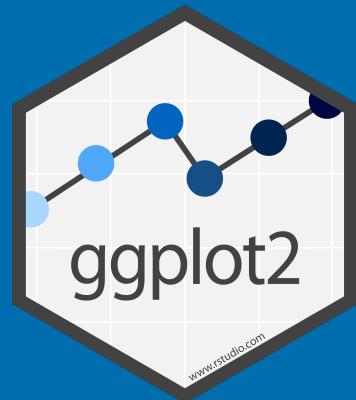
How are **barplots** different to a **pie chart**? 🤔



Don't they all **depict the same information?** 😐

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# Grammar of graphics



# Basic structure of ggplot

```
ggplot(data = <data>, mapping = aes(<mappings>)) +  
<layer>()
```



1. **data** as `data.frame` (or `tibble`),
2. a set of **aesthetic** mappings between variables in the data and visual properties, and
3. at least one **layer** which describes how to render each observation.

demo data for today



# Palmer penguins

penguins data is from the palmerpenguins 📦

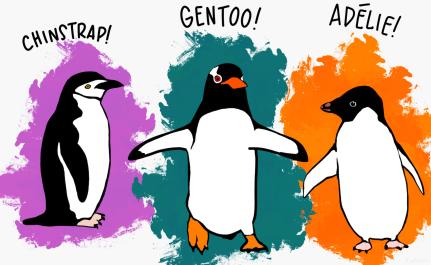
```
library(palmerpenguins)
```

```
glimpse(penguins)
```

```
## Rows: 344
```

```
## Columns: 8
```

```
## $ species
```



```
<fct> Adelie, Adelie, Adelie,
```

```
<fct> Torgersen, Torgersen, T
```

```
<dbl> 39.1, 39.5, 40.3, NA, 3
```

```
<dbl> 18.7, 17.4, 18.0, NA, 1
```

```
<int> 181, 186, 195, NA, 193,
```

```
<int> 3750, 3800, 3250, NA, 3
```

```
<fct> male, female, female, N
```

```
<int> 2007, 2007, 2007, 2007,
```

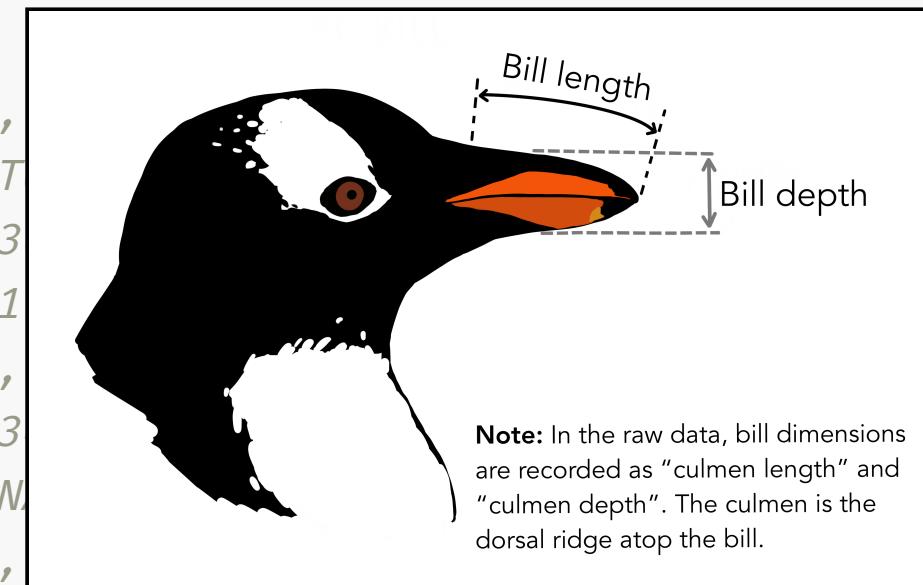
```
## $ sex
```

```
## $ year
```

Horst AM, Hill AP, Gorman KB (2020). palmerpenguins: Palmer Archipelago (Antarctica) penguin data. R package version 0.1.0.

<https://allisonhorst.github.io/palmerpenguins/>

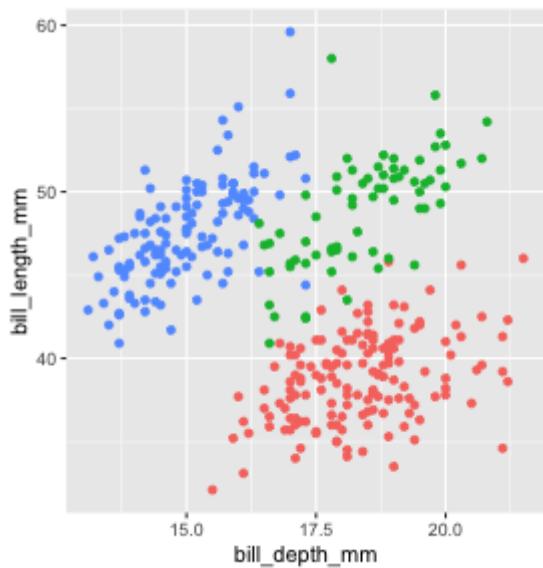
Gorman KB, Williams TD, Fraser WR (2014). Ecological sexual dimorphism and environmental variability within a community of Antarctic penguins (genus Pygoscelis). PLoS ONE 9(3):e90081.



# Aesthetic mappings

aesthetic = column in data

```
ggplot(data = penguins,  
       mapping = aes(x = bill_depth_mm, y = bill_length_mm, color = species)) +  
geom_point()
```



`aes(x = bill_depth_mm, y = bill_length_mm, color = species)`

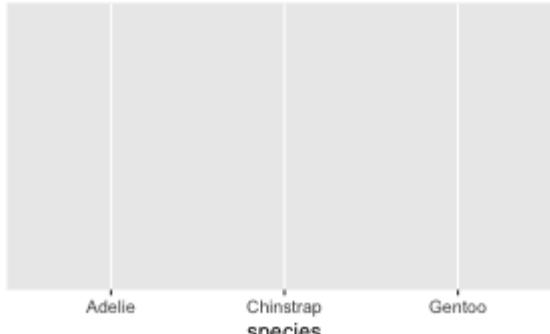
year	sex	body_mass_g	flipper_length_mm	bill_depth_mm	bill_length_mm	island	species

- `bill_depth_mm` is mapped to the x coordinate
- `bill_length_mm` is mapped to the y coordinate
- `species` is mapped to the color

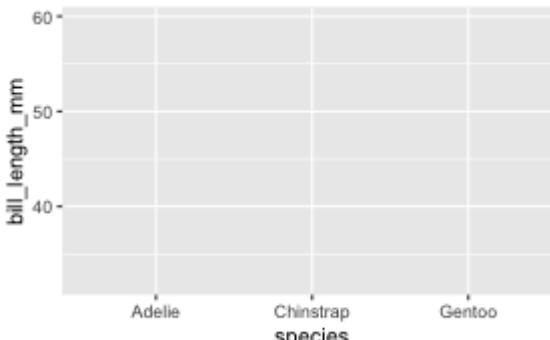
# Hidden argument names in ggplot

```
ggplot(data = <data>, mapping = aes(x = <x>, y = <y>, <other mappings>))
```

```
ggplot(penguins, aes(species))
```



```
ggplot(penguins, aes(species, bill_length_mm))
```



- No need to write explicitly write out `data =`, `mapping =`, `x =`, and `y =` each time in `ggplot`.
- `ggplot` code in the wild often omit these argument names.
- But position needs to be correct if argument names are not specified!
- If no layer is specified, then the plot is `geom_blank()`.

# Layer



Each layer has a

- `geom` - the geometric object to use display the data,
- `stat` - statistical transformations to use on the data,
- `data` and `mapping` which is usually inherited from `ggplot` object,

Further specifications are provided by `position` adjustment, `show_legend` and so on.

# Example layer: geom\_point()

The <layer> is usually created by a function preceded by geom\_ in its name.

```
ggplot(penguins, aes(bill_depth_mm, bill_length_mm)) +  
  geom_point()
```

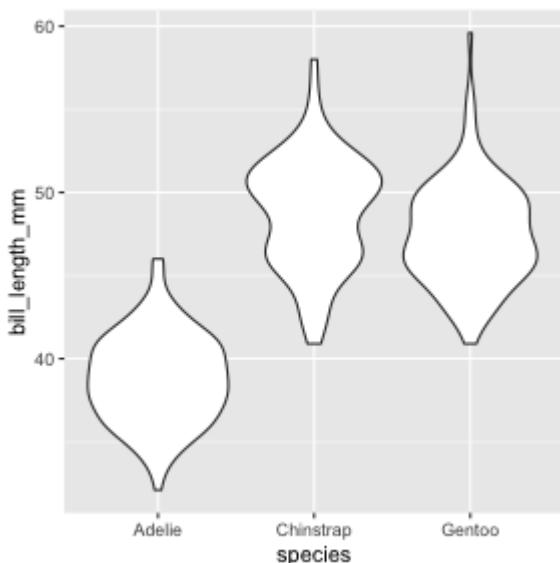
is a shorthand for

```
ggplot(penguins, aes(bill_depth_mm, bill_length_mm)) +  
  layer(geom = "point",  
        stat = "identity", position = "identity",  
        params = list(na.rm = FALSE))
```

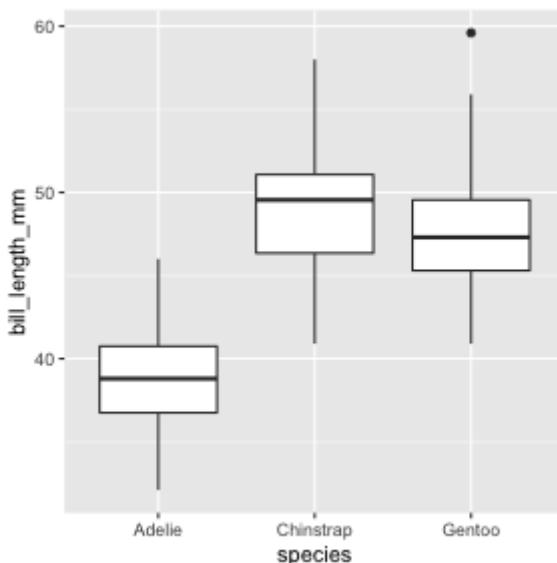
# Different geometric objects

```
p <- ggplot(penguins, aes(species, bill_length_mm))
```

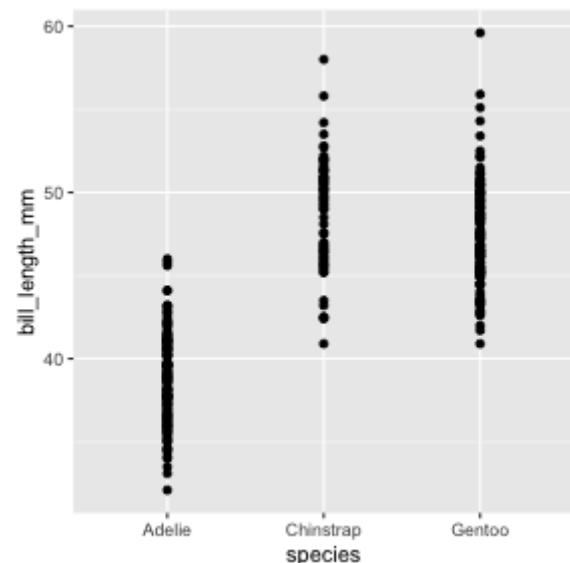
```
p + geom_violin()
```



```
p + geom_boxplot()
```



```
p + geom_point()
```

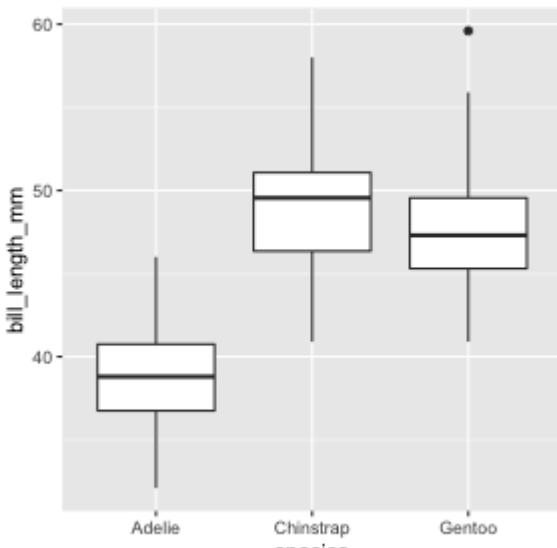


# geom

geom	Description
geom_abline, geom_hline, geom_vline	Reference lines: horizontal, vertical, and diagonal
geom_bar, geom_col	Bar charts
geom_bin_2d, geom_bin2d	Heatmap of 2d bin counts
geom_blank	Draw nothing
geom_boxplot	A box and whiskers plot (in the style of Tukey)
geom_contour, geom_contour_filled	2D contours of a 3D surface
geom_count	Count overlapping points
geom_density	Smoothed density estimates
geom_density_2d, geom_density2d, geom_density_2d_filled, geom_density2d_filled	Contours of a 2D density estimate
geom_dotplot	Dot plot

# Statistical transformation

```
g <- ggplot(penguins, aes(species, bill_length_mm)) + geom_boxplot()
```



- The y-axis is not the raw data!
- It is plotting a statistical transformation of the y-values.
- Under the hood, data is transformed (including x factor input to numerical values).

```
layer_data(g, 1)
```

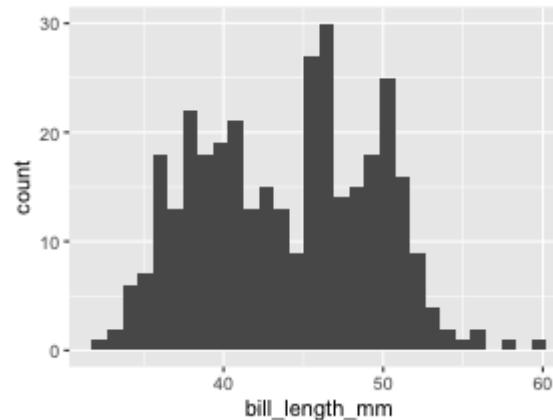
```
##   ymin lower middle upper ymax outliers notchupper notchlower
## 1 32.1 36.75 38.80 40.750 46.0          39.31431 38.28569
## 2 40.9 46.35 49.55 51.075 58.0          50.45532 48.64468
## 3 40.9 45.30 47.30 49.550 55.9          59.6        47.90547 46.69453
##   xmax xid newx new_width weight colour fill size alpha shape
## 1 1.375  1    1     0.75   1 grey20 white  0.5  NA   19
## 2 2.375  2    2     0.75   1 grey20 white  0.5  NA   19
## 3 3.375  3    3     0.75   1 grey20 white  0.5  NA 14/29
```

# Statistical transformation: stat\_bin

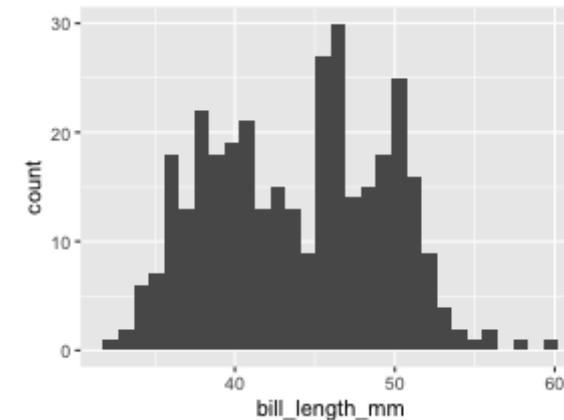
- For geom\_histogram, default is stat = "bin".
- For stat\_bin, default is geom = "bar".
- Every geom has a stat and vice versa.

```
p <- ggplot(penguins, aes(bill_length_mm))
```

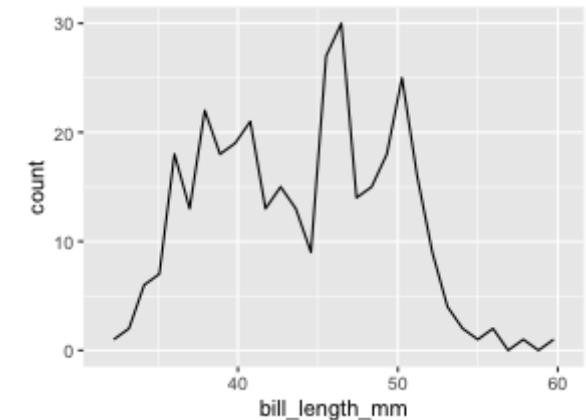
```
p + geom_histogram()
```



```
p + stat_bin(geom = "bar")
```



```
p + stat_bin(geom = "line")
```



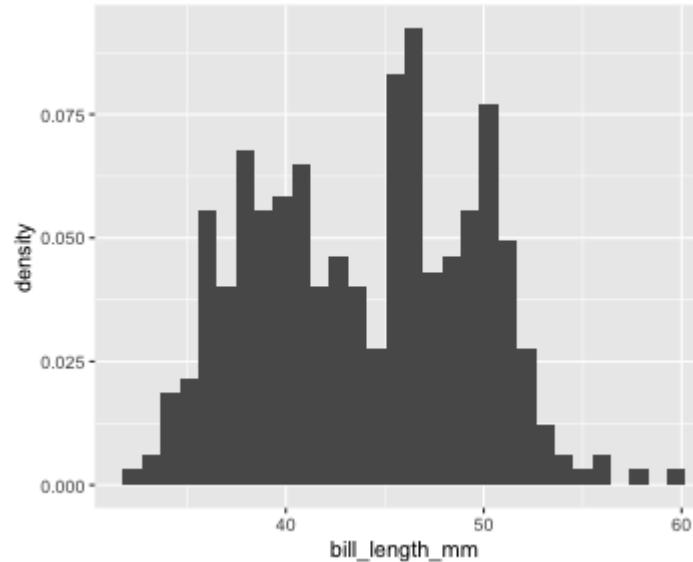
# Using statistical transformations

To map an aesthetic to computed statistical variable (say called `var`), you can refer to it by either `stat(var)` or `..var..`

```
stat = "bin"
```

```
##          x count      density
## 1 32.24138     1 0.003083466
## 2 33.18966     2 0.006166932
## 3 34.13793     6 0.018500797
## 4 35.08621     7 0.021584264
## 5 36.03448    18 0.055502392
## 6 36.98276    13 0.040085061
## 7 37.93103    22 0.067836257
## 8 38.87931    18 0.055502392
## 9 39.82759    19 0.058585859
## 10 40.77586   21 0.064752791
## 11 41.72414   13 0.040085061
```

```
p + geom_histogram(aes(y = stat(density) ))
```



```
p + geom_histogram(aes(y = ..density.. ))
```

# stat

stat	Description
stat_count	Bar charts
stat_bin_2d, stat_bin2d	Heatmap of 2d bin counts
stat_boxplot	A box and whiskers plot (in the style of Tukey)
stat_contour, stat_contour_filled	2D contours of a 3D surface
stat_sum	Count overlapping points
stat_density	Smoothed density estimates
stat_density_2d, stat_density2d, stat_density_2d_filled	Contours of a 2D density estimate
stat_function	Draw a function as a continuous curve
stat_bin_hex, stat_binhex	Hexagonal heatmap of 2d bin counts
stat_bin	Histograms and frequency polygons

Previous

1

2

3

Next

# Constructing plots with R: ggplot2 version

df

```
## # A tibble: 3 × 2
##   duty      perc
##   <chr>    <dbl>
## 1 Teaching     40
## 2 Research     40
## 3 Admin        20
```

▶ base version

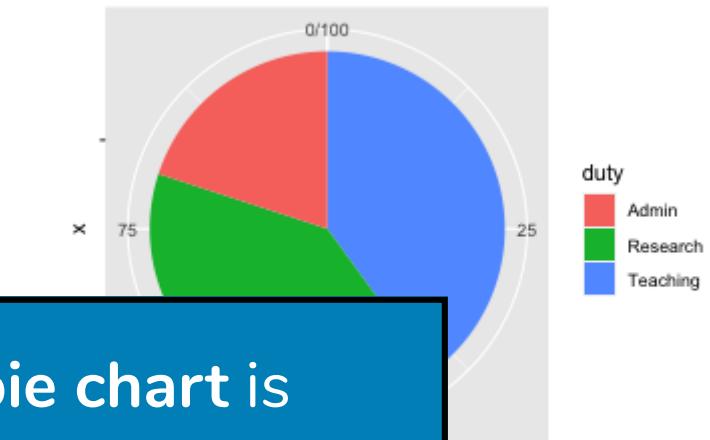
## Stacked barplot

```
ggplot(df, aes(x = "", # dummy
                y = perc,
                fill = duty)) +
  geom_col()
```



## Pie chart

```
ggplot(df, aes(x = "", # dummy
                y = perc,
                fill = duty)) +
  geom_col() +
  coord_polar(theta = "y")
```



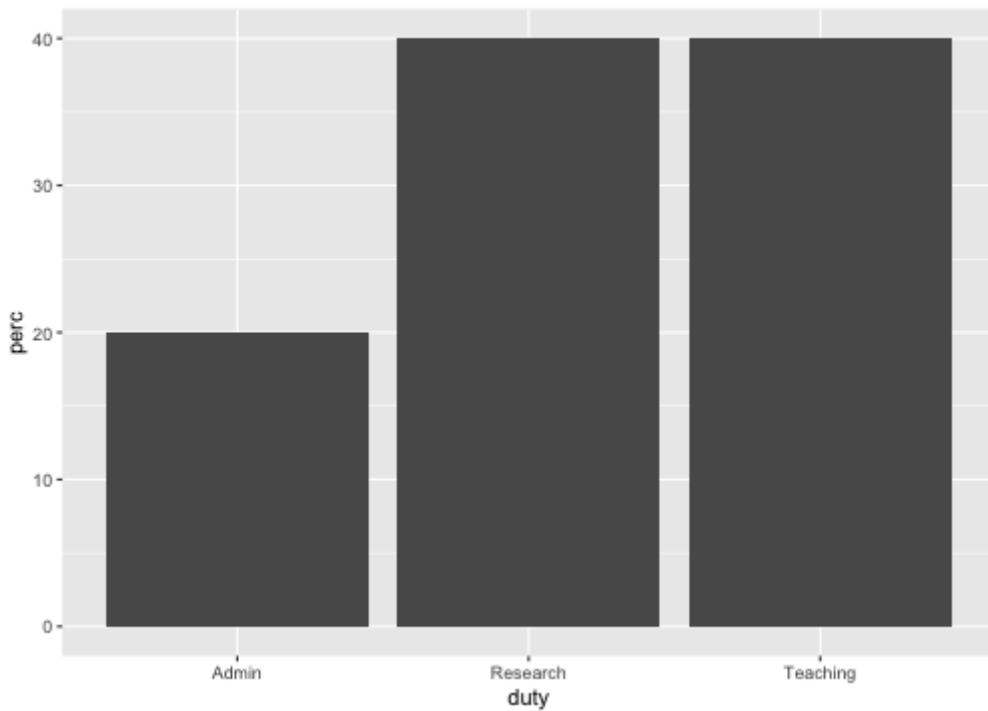
The difference between a **stacked barplot** and a **pie chart** is that the coordinate system have been transformed from **Cartesian coordinate to polar coordinate**.



# 🧩 How do we create this barplot in ggplot?

```
df  
  
## # A tibble: 3 × 2  
##   duty      perc  
##   <chr>     <dbl>  
## 1 Teaching    40  
## 2 Research    40  
## 3 Admin       20  
  
barplot(df$perc, names.arg = df$duty)
```

```
ggplot(data = df,  
        aes(x = duty, y = perc)) +  
  geom_col()
```

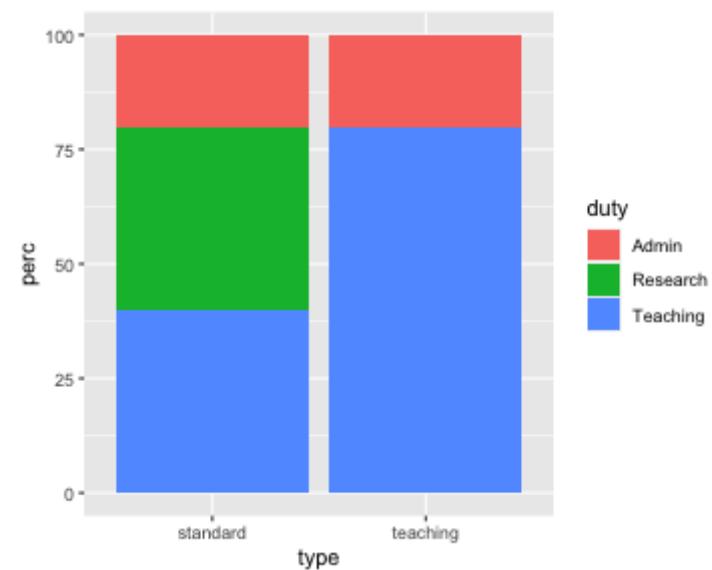


# What graph will this yield?

df2

```
## # A tibble: 6 × 3
##   duty      perc type
##   <chr>    <dbl> <chr>
## 1 Teaching     40 standard
## 2 Research     40 standard
## 3 Admin        20 standard
## 4 Teaching     80 teaching
## 5 Research      0 teaching
## 6 Admin        20 teaching
```

```
g <- ggplot(df2,
             aes(x = type,
                  y = perc,
                  fill = duty)) +
  geom_col()
```



```
g + coord_polar("y")
```



`</> Open part1-exercise-01.Rmd`

15 : 00

# Session Information

```
devtools::session_info()
```

```
## - Session info 🤝 😭 🤝
## hash: raised fist: medium-dark skin tone, crying face, raised fist
##
## setting value
## version R version 4.1.2 (2021-11-01)
## os      macOS Big Sur 11.6.2
## system x86_64, darwin17.0
## ui      RStudio
## language (EN)
## collate en_AU.UTF-8
## ctype   en_AU.UTF-8
## tz      Australia/Melbourne
## date   2022-02-20
```

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