# ggplot2 tutorial

**References and useful information**
Examples based on https://r4ds.had.co.nz/data-visualisation.html
List of functions and function reference https://ggplot2.tidyverse.org/reference/#section-plot-basics
Useful for understanding geometry layers https://rpubs.com/hadley/ggplot2-layers
Further exercises and advanced functionality https://r4ds.had.co.nz/graphics-for-communication.html

There are entire books on ggplot2
Complex but flexible and powerful plotting library
Based on 'the grammar of graphics

**ggplot components**
ggplot object
geom layers
aes mapping
scales
faceting specifications
coordinate systems

ggplot() object
creates a coordinate system to which layers can be added
arg 1: data = 'dataset'

geom layers
geom_point() adds a layer of points creating a scatterplot

aes() mapping
the x and y args of the aes() function are where the variables to be mapped onto coordinate system are given. ggplot looks in the ggplot() object data argument for these variables

**Basic generic use template**
```
ggplot(data = 'dataset') +
        'geom_function'(mapping = aes('mappings'))
```

**mpg scatterplot example**

ggplot(data=mpg) assign data, blank plot

```
ggplot(data=mpg) +
  geom_point(mapping=aes(x=displ,y=hwy))
```
basic scatter plot using geom_point() layer and mapping of variables within mpg dataframe

Aesthetic properties include size, shape and colour of points
```
ggplot(data=mpg) +
  geom_point(mapping=aes(x=displ,y=hwy, color=class))
```
the points are coloured by passing a variable in the dataframe to the the aes argument color

```
ggplot(data=mpg) +
  geom_point(mapping=aes(x=displ,y=hwy, size=class))  size (continuous variable recommended)
```

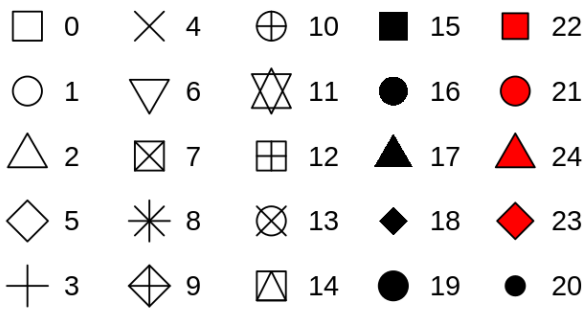
```
ggplot(data=mpg) +
  geom_point(mapping=aes(x=displ,y=hwy, alpha=class)) transparency (continuous variable recommended)

ggplot(data=mpg) +
  geom_point(mapping=aes(x=displ,y=hwy, shape=class)) shape (only 6 available automatically)
```

**Manual aesthetics**

manual point aesthetics need to be set outside of the aes mapping as they do not derive from the dataframe

```
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy, color = "blue"))
```

color: name of color as a string
size: size in mm
shape: one of the following numbers below




**Facet wrap**

```
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy)) +
  facet_wrap(~ class, nrow = 2)
```

separate into individual plots by class and arrange in 2 rows

```
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy)) +
  facet_grid(drv ~ cyl)
```

separate into individual plots by drive type and number of cylinders arranged as a grid

**Multiple geometry layers**

```
ggplot(data = mpg) +
  geom_smooth(mapping = aes(x = displ, y = hwy))

ggplot(data = mpg) +
  geom_smooth(mapping = aes(x = displ, y = hwy, linetype = drv))

ggplot(data = mpg) +
  geom_point(mapping=aes(x=displ,y=hwy, color=drv)) +
  geom_smooth(mapping = aes(x = displ, y = hwy, linetype = drv))
```

**Global mapping**

```
ggplot(data = mpg, mapping = aes(x = displ, y = hwy)) +
  geom_point(mapping=aes(color=drv)) +
  geom_smooth(mapping=aes(linetype=drv))
```

**Bar plot**

```
ggplot(data=mpg) +
  geom_bar(mapping=aes(x=class))
```

bar charts, histograms, and frequency polygons bin your data and then plot bin counts, the number of points that fall in each bin.

smoothers fit a model to your data and then plot predictions from the model.

boxplots compute a robust summary of the distribution and then display a specially formatted box.

**Stat transformations**

```
ggplot(data=mpg) +
  stat_count(mapping=aes(x=class))
```

**Coordinates**

```
ggplot(data = mpg, mapping = aes(x = class, y = hwy)) +
  geom_boxplot()
ggplot(data = mpg, mapping = aes(x = class, y = hwy)) +
  geom_boxplot() +
  coord_flip()

bar <- ggplot(data = mpg) +
  geom_bar(
    mapping = aes(x = class, fill = class),
    show.legend = FALSE,
    width = 1
  ) +
  theme(aspect.ratio = 1) +
  labs(x = NULL, y = NULL)

bar + coord_flip()
bar + coord_polar()
```

**The structure of graphical grammar**

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(
     mapping = aes(<MAPPINGS>),
     stat = <STAT>,
     position = <POSITION>
  ) +
  <COORDINATE_FUNCTION> +
  <FACET_FUNCTION>
```