ggplot2

Grammar of Graphics

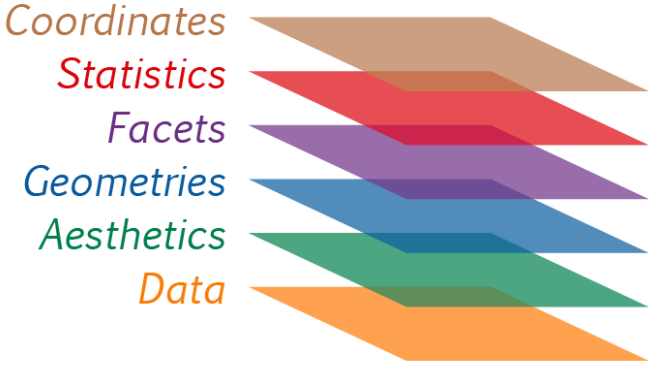
2 principles

1. Graphics = distinct layers of grammatical elements
2. Meaningful plots through aesthetic mapping

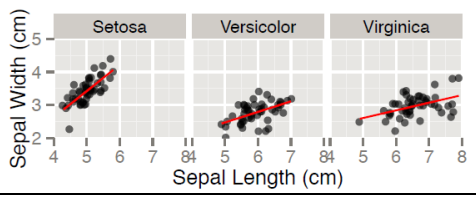
Element	Description
Data	The dataset being plotted.
Aesthetics	The scales onto which we *map* our data.
Geometries	The visual elements used for our data.
Facets	Plotting small multiples.
Statistics	Representations of our data to aid understanding.
Coordinates	The space on which the data will be plotted.
Themes	All non-data ink.

Data	*{variables of interest}*				
Aesthetics	*x-axis* *y-axis*	*colour* *fill*	*size* *labels*	*alpha* *shape*	*line width* *line type*
Geometries	*point*	*line*	*histogram*	*bar*	*boxplot*
Facets	*columns*	*rows*			
Statistics	*binning*	*smoothing*	*descriptive*	*inferential*	
Coordinates	*cartesian*	*fixed*	*polar*	*limits*	
Themes	*non-data ink*				

```
ggplot(mtcars, aes(x = wt, y = mpg)) + geom_point()
ggplot(mtcars, aes(x = wt, y = mpg, color = disp)) + geom_point()
ggplot(mtcars, aes(x = wt, y = mpg, size = disp)) + geom_point()
```



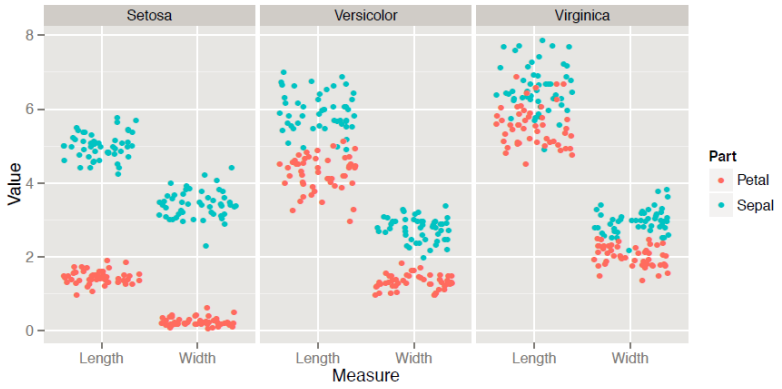

```
> levels(iris$Species) <- c("Setosa", "Versicolor", "Virginica")
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
    geom_jitter(alpha = 0.6) +
    facet_grid(. ~ Species) +
    stat_smooth(method = "lm", se = F, col = "red") +
    scale_y_continuous("Sepal Width (cm)",
                       limits = c(2,5),
                       expand = c(0,0)) +
    scale_x_continuous("Sepal Length (cm)",
                       limits = c(4,8),
                       expand = c(0,0)) +
    coord_equal()
```



Data

iris.wide (pg15) & iris.tidy (pg23) & facet_grid()

```
> ggplot(iris.tidy, aes(x = Measure, y = Value, col = Part)) +
    geom_jitter() +
    facet_grid(. ~ Species)
```



Aesthetics

- Column can be mapped onto visible ***aesthetic***
- Aesthetics in aes(), ***attributes*** in geom_(col="red")
- aes() can also be called in geom_(), but done usually when you want to include multiple data sources
- ggplot(mtcars, aes(x=wt, y=mpg, fill=cyl, col=am)) + geom_point(**shape**=21, **size**=4, **alpha**=0.6)
    - aes has to be associated with columns
    - attributes are given along with geom_*() and don't have columns associated with them
- ggplot(mtcars, aes(x = wt, y = mpg, fill = cyl, **label**=rownames(mtcars))) + geom_**text**(color='red')
- **Modifying Aesthetics**
    - geom_bar(**postion**="< stack, fill, dodge, … >")
    - **scale_*** functions
        - scale_x/y_continuous/discrete("title", limits, breaks, expand, ….)
    - **labs**(x,y,col, …)

Aesthetics for Continuous Variables

Aesthetic	Description
x	X axis position
y	Y axis position
size	Diameter of points, thickness of lines
alpha	Transparency
colour	Colour of dots, outlines of other shapes
fill	Fill colour

Aesthetics for Categorical Variables

Aesthetic	Description
labels	Text on a plot or axes
fill	Fill colour
shape	Shape of point
alpha	Transparency
linetype	Line dash pattern
size	Diameter of points, thickness of lines

Geometry Layer

Scatter Plots: geom_point()

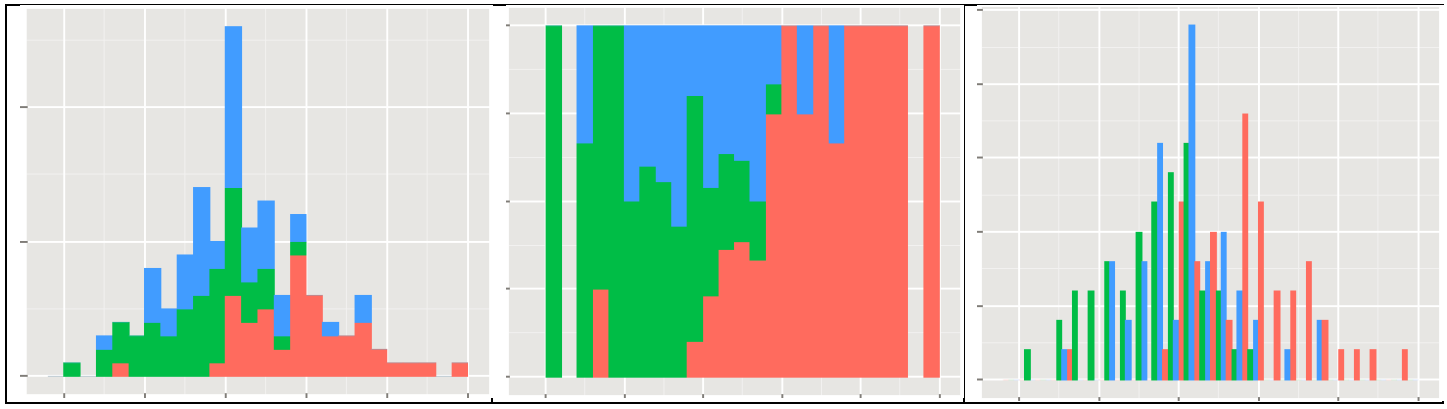
- aes() inside geom_*() is same as aes() in ggplot()

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
    geom_point() +      inherits data and aes from ggplot()
    geom_point(data = iris.summary, shape = 15, size = 5)    different data inherits aes
```

- ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) + geom_**jitter**(**shape**=1, **alpha**=0.6)
    - to visualize the density, use jitter along with alpha & shape(hollow shapes preferred)

Bar Plots:

- **Histogram**: geom_histogram() : x-axis : continuous variables
    - ggplot(df, aes(x=x1)) + geom_histogram(**binwidth**=0.1)
    - ggplot(df, aes(x=x1)) + geom_histogram(aes(y=**..density..**), binwidth=0.1)
    - ggplot(df, aes(x=x1, fill=cat_var)) + geom_histogram(binwidth=0.1, **position**="stack/fill/dodge")



- **Bar Plot**: geom_bar() : x-axis = categorical variables
    - ggplot(df, aes(x=cat_var)) + geom_bar(stat="bin")
    - Custom Color Palettes

```
blues <- brewer.pal(9, "Blues")
blue_range <- colorRampPalette(blues)
ggplot(Vocab, aes(x = education, fill = vocabulary)) +
    geom_bar(position = "fill") +
    scale_fill_manual(values=blue_range(11))
```

    - Overlapping bar plots

```
posn_d <- position_dodge(width=0.2)
ggplot(mtcars, aes(x = cyl, fill = am)) + geom_bar(position=posn_d)
```

- **Line Plots:** geom_line()
    - Plotting different categories

```
ggplot(df, aes(x=Year, y=Capture, linetype=Species)) + geom_line()
```

    - Proportional Trends

```
ggplot(df, aes(x=Year, y=Capture, fill=Species)) + geom_area(position="fill")
```

    - ggplot(economics, aes(x=date, y=unemploy/pop)) + **geom_rect**(data=recess, aes(xmin=begin, xmax=end, ymin=-Inf, ymax=+Inf), **inherit.aes=FALSE**, fill="red", alpha=0.2) + geom_line()

qplot

- Quick and dirty way for plotting, not very flexible, doesn’t follow grammar of graphics
- qqplot(x, y, data, shape/size/col, postion, jitter, alpha=I(value))

Wrap-Up

iris	Species	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width
iris.wide	Species	Part	Length	Width	
iris.mixed	Species.Part	Length	Width		
iris.tidy	Species	Part	Measure	Value	

Choice of data format depends on desired plot!