Data Visualization with ggplot2

by Erika Siregar (@erikaris) Presented in R-Ladies Bogor Meetup

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Why do we visualize?

- to get better understanding of the data.
- to understand relationship between variables.
- to help discovering insights.

How to visualize in R?

- basic R plot
- ggplot2

What is ggplot2?

- ggplot2 is a library for declaratively creating graphics
- it is based on The Grammar of Graphics.
  - Grammar of Graphics is a concept that defines a plot as a set of component layers: **aesthetic and geometry**.
  - You **provide the data**, tell ggplot2 how to map variables to **aesthetics**, what graphical **geometries** to use, and it takes care of the details.

Grammar of Graphic

A plot is basically a stack of layers consisting of:

- data

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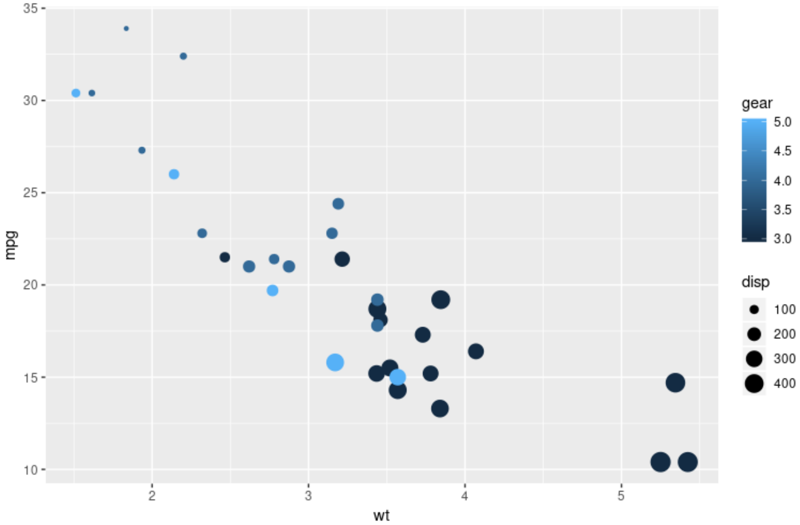
A plot is basically a stack of layers consisting of:

- data
- aesthetic –> aes()
- geometry –> geom_
- theme –> theme()

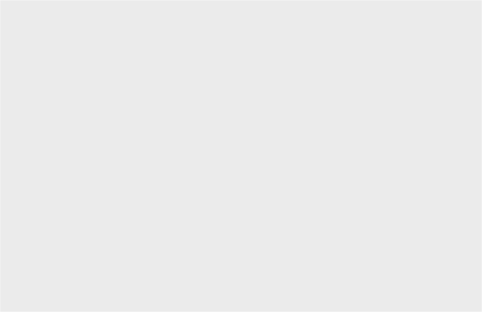
Take a look at this plot

A scatter plot of `mtcars` data with `x` and `y` axes are mapped to `wt` and `mpg` columns, respectively.



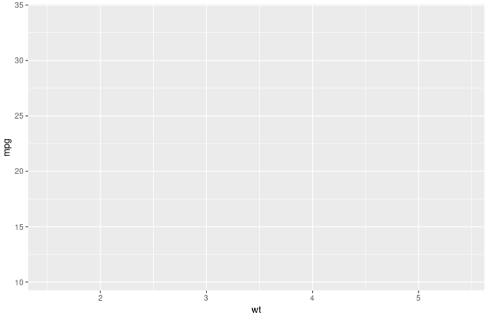
Now, look at the graphic in a ‘Grammar of Graphics’ way.

A plot is just a blank canvas



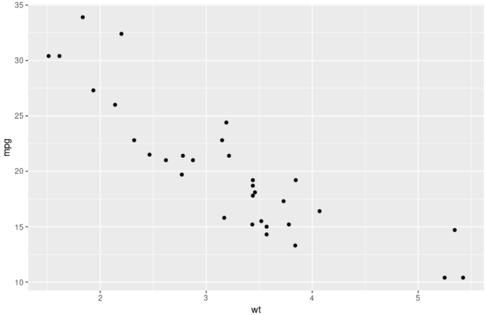
Now, look at the graphic in a ‘Grammar of Graphics’ way.

A plot is just a blank canvas + aesthetic



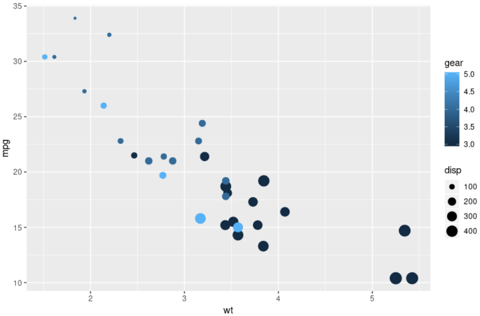
Now, look at the graphic in a ‘Grammar of Graphics’ way.

A plot is just a blank canvas + aesthetic + geometry



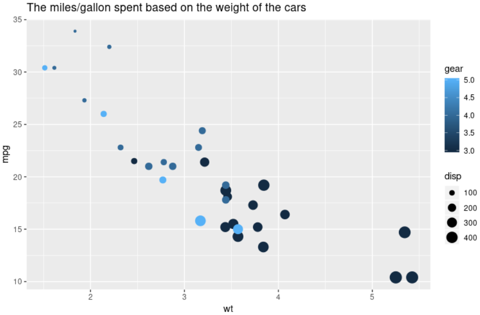
Now, look at the graphic in a ‘Grammar of Graphics’ way.

A plot is just a blank canvas + aesthetic + geometry + more aesthetics



Now, look at the graphic in a ‘Grammar of Graphics’ way.

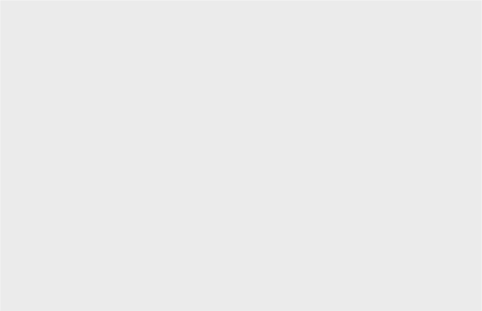
A plot is just a blank canvas + aesthetic + geometry + more aesthetics + labels



Translate the Grammar of Graphics to ggplot

A plot is just a blank canvas

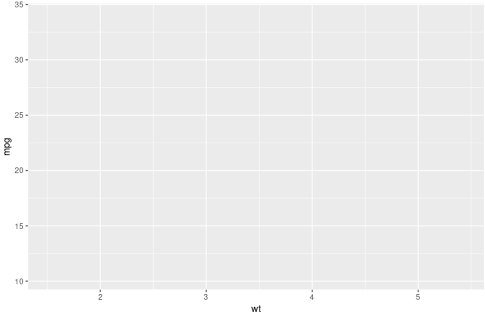
```r
ggplot(mtcars)
```



Translate the Grammar of Graphics to ggplot

A plot is just a blank canvas + aesthetic

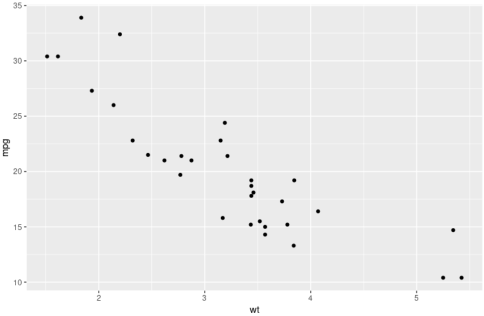
```
ggplot(mtcars, aes(x = wt, y = mpg))
```



Translate the Grammar of Graphics to ggplot

A plot is just a blank canvas + aesthetic + geometry

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



Translate the Grammar of Graphics to ggplot

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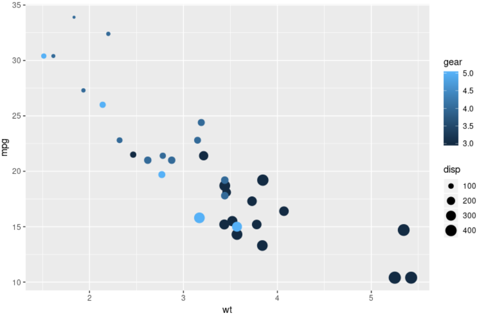
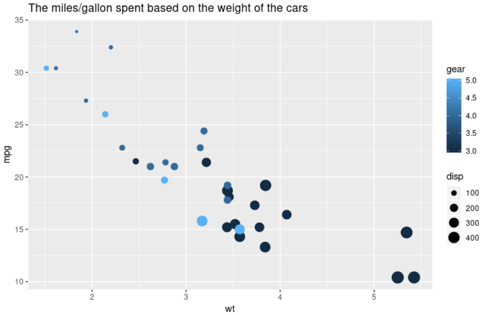


Translate the Grammar of Graphics to ggplot

A plot is just a blank canvas + aesthetic + geometry + more aesthetics + labels

```
ggplot(mtcars, aes(x = wt, y = mpg, size = disp, color =
geom_point() +
labs(title = "The miles/gallon spent based on the weight
```



Drawing your first plot

Preparation

- Make sure you have the library installed on your machine:

```r
install.packages('ggplot2')
```

- load the ggplot library:

```r
library(ggplot2)
```

- use the dataset mtcars, available in R Studio.
  - explore its structure:

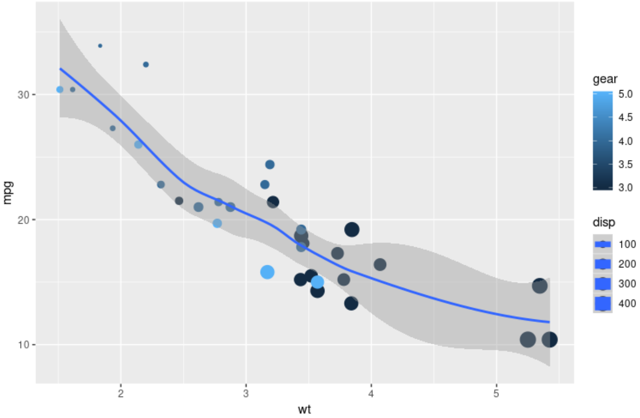
```r
str(mtcars)
```

Now replicate this script on your own machine.

```r
library(ggplot2)

ggplot(mtcars, aes(x = wt, y = mpg, size = disp, color =
  geom_point() +
  geom_smooth()
  labs(title = "The miles/gallon spent based on the weigh
```

Your output should look like this:



Playing with geoms

Spend your time playing with different types of geoms by just simply changing the geom from the example that we have created earlier.

geom_bar

```r
library(ggplot2)
ggplot(mtcars, aes(x = factor(cyl),
                   fill = factor(am))) +
  # try position = 'dodge', 'fill'
  geom_bar(position = 'dodge') +
  scale_x_discrete('Cylinders') +
  scale_y_continuous('Number') +
  scale_fill_manual('Transmission',
    values = c("#E41A1C", "#377EB8"),
    labels = c("Manual", "Automatic"))
```

histogram

1 - Make a univariate histogram

```
ggplot(mtcars, aes(x = mpg)) +
  geom_histogram()
```

2 - Plot 1, plus set binwidth to 1 in the geom layer

```
ggplot(mtcars, aes(x = mpg)) +
  geom_histogram(binwidth = 1)
```

3 - Plot 2, plus MAP ..density.. to the y aesthetic (i.e. in a second aes() function)

```
ggplot(mtcars, aes(x = mpg)) +
  geom_histogram(binwidth = 1, aes(y = ..density..))
```

4 - plot 3, plus SET the fill attribute to "#377EB8"

```
ggplot(mtcars, aes(x = mpg)) +
  geom_histogram(binwidth = 1, fill = "#377EB8", aes(y = .
```

Playing with aesthetics

Basic scatter plot: wt on x-axis and mpg on y-axis; map cyl to col

```
ggplot(mtcars, aes(x=wt, y=mpg, color=cyl)) + geom_point(s
```

Hollow circles

```
ggplot(mtcars, aes(x=wt, y=mpg, color=cyl)) + geom_point(s
```

Add transparency

```
ggplot(mtcars, aes(x=wt, y=mpg, color=cyl)) + geom_point(s
```

Playing with facet

- Facet = splitting a plot into several subplots.
- Let’s play using the iris dataset.
- Let’s take a brief look into the dataset

```
str(iris)
```

```
## 'data.frame':    150 obs. of  5 variables:
##  $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.
##  $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9
##  $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.
##  $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.
##  $ Species     : Factor w/ 3 levels "setosa","versicolo
```

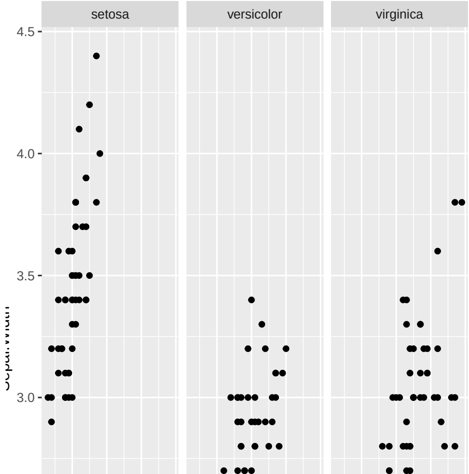
```
names(iris)
```

```
## [1] "Sepal.Length" "Sepal.Width"  "Petal.Length" "Petal
## [5] "Species"
```

Playing with facet

Now, let's start playing

```
ggplot(iris, aes(x=Sepal.Length, y=Sepal.Width))+
  geom_point() +
  facet_grid(. ~ Species)
```

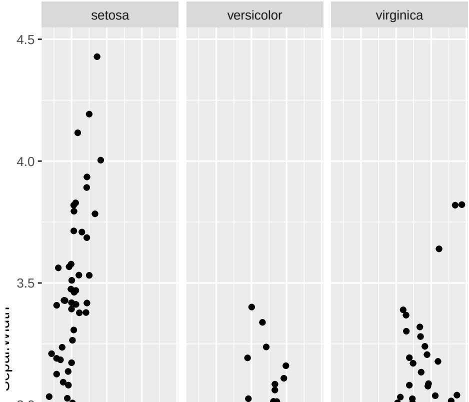


Playing with facet

use geom_jitter() instead of geom_point()

```r
library(ggplot2)

ggplot(iris, aes(x=Sepal.Length, y=Sepal.Width))+
  geom_point() +
  facet_grid(. ~ Species)
```

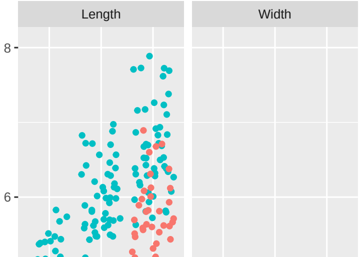


Playing with facet

Now, let's level up the game a bit. Modify the iris dataset to get a more interesting visualization.

```
library(tidyr)

iris %>%
  gather(key, value, -Species) %>%
  separate(key, c("Part","Measure"), sep="\\.") %>%
  ggplot(aes(x = Species, y = value, col = Part)) +
  geom_jitter() +
  facet_grid(. ~ Measure)
```

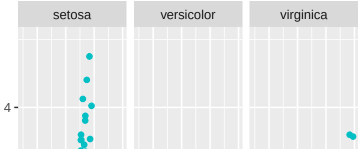


Playing with facet

Give it another try!

```
library(tidyr)
library(dplyr)
library(ggplot2)

iris %>%
  mutate(Flower = 1:nrow(iris)) %>%
  gather(key, value, -Species, -Flower) %>%
  separate(key,c("Part", "Measure"),sep="\\.")%>%
  spread(Measure, value) %>%
  ggplot(aes(x=Length, y=Width, color=Part)) +
  geom_jitter() +
  facet_grid(. ~ Species)
```



Questions?