Class 5: Data Viz with ggplot

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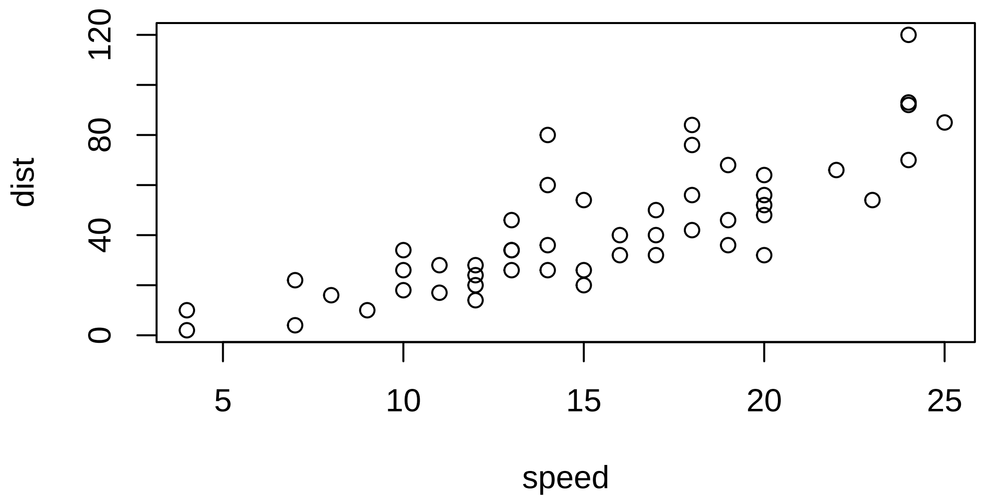
R has a lot of ways to make figures and graphs. In particular, one that comes with R out of the box is called **"base" R** - the `plot()` function.

```r
plot(cars)
```



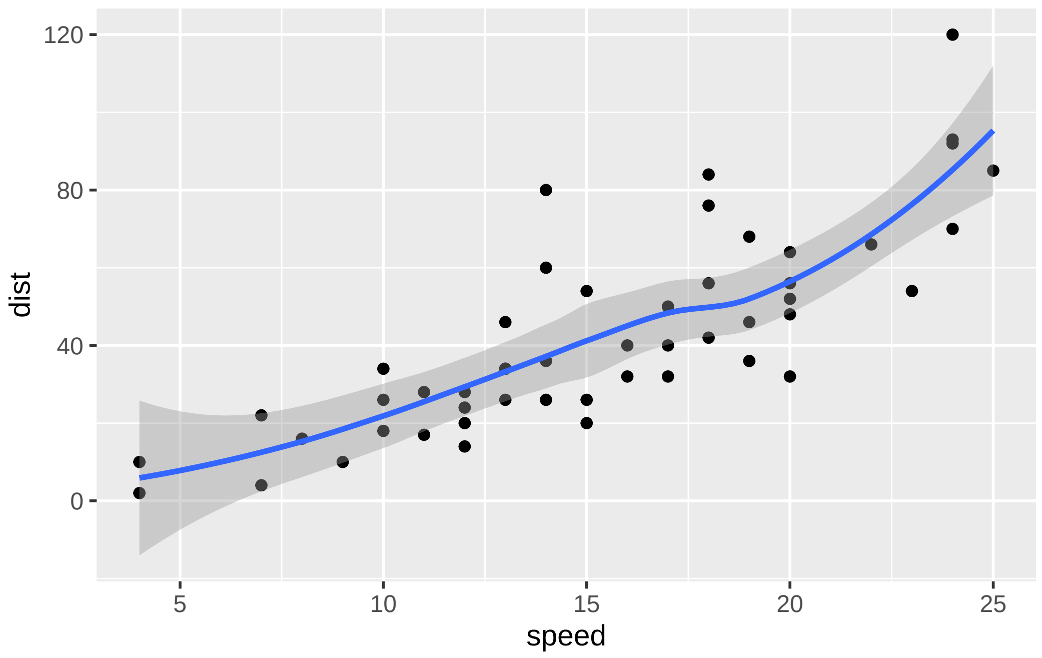
A very popular package is called **ggplot2**

Before I can use any add-on package like this one I must install it. We can use the `install.packages("ggplot2")` command. Install the add-on on the console.

Before using, I need to call it with `library()`

```r
library(ggplot2)
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point() +
  geom_smooth()
```

```
`geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



Remember that ggplot works in layers. You need to add them in order to get the data displayed. Every ggplot has at least 3 layers:

- **data** (the number or stuff you want to plot –usually a data frame `data.frame`–)
- **aes**thetics (mapping of your columns in the data frame to your plot –position x,y; size, line type, line width, color, shape)
- **geom**s (there are tones of these; basics are `geom_point()`, `geom_line()`, `geom_col()`)

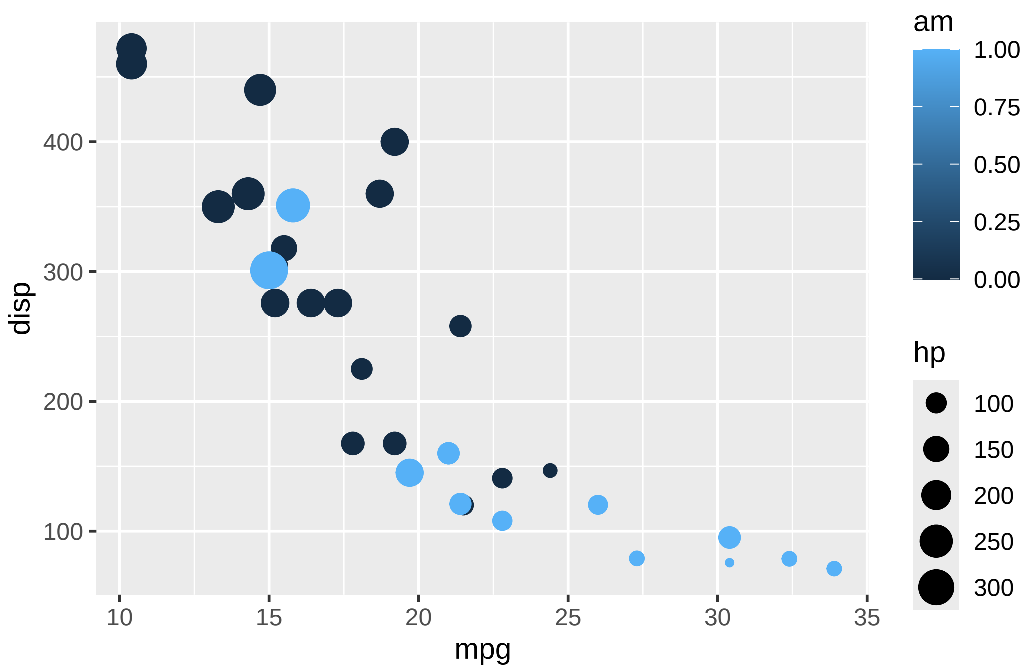
```r
mtcars
```

```
                   mpg cyl  disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
```

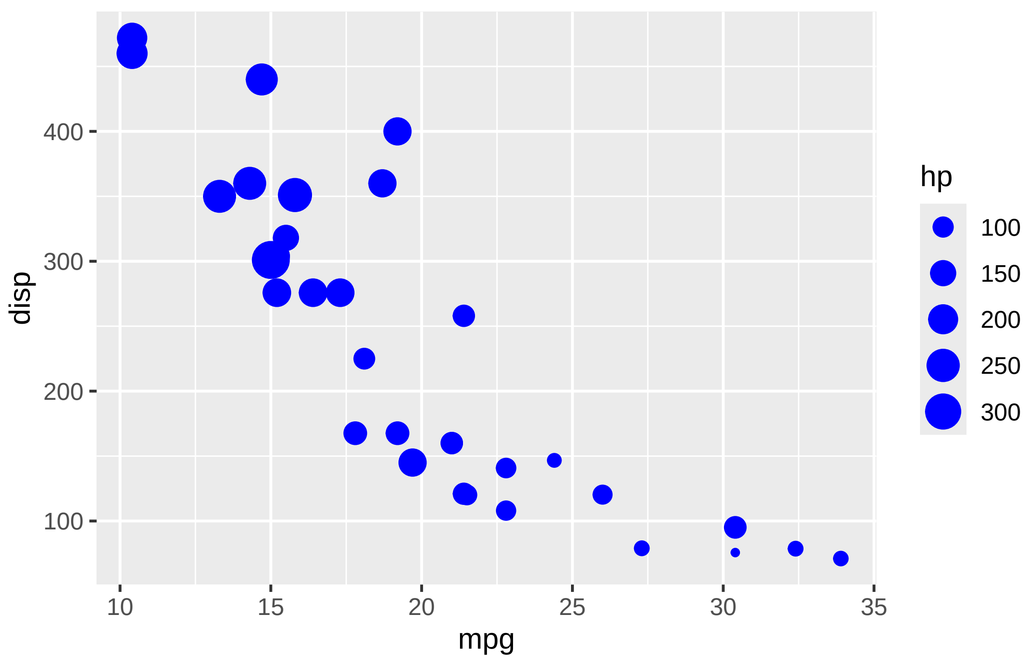
```
Hornet 4 Drive      21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
Valiant             18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
Merc 240D           24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
Merc 230            22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
Merc 280            19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
Merc 280C           17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
Merc 450SL          17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
```

Make a ggplot of `mtcars` data set using `mpg` vs `disp`. Set the size of the points to the `hp`. Also, set the color to `am`.

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

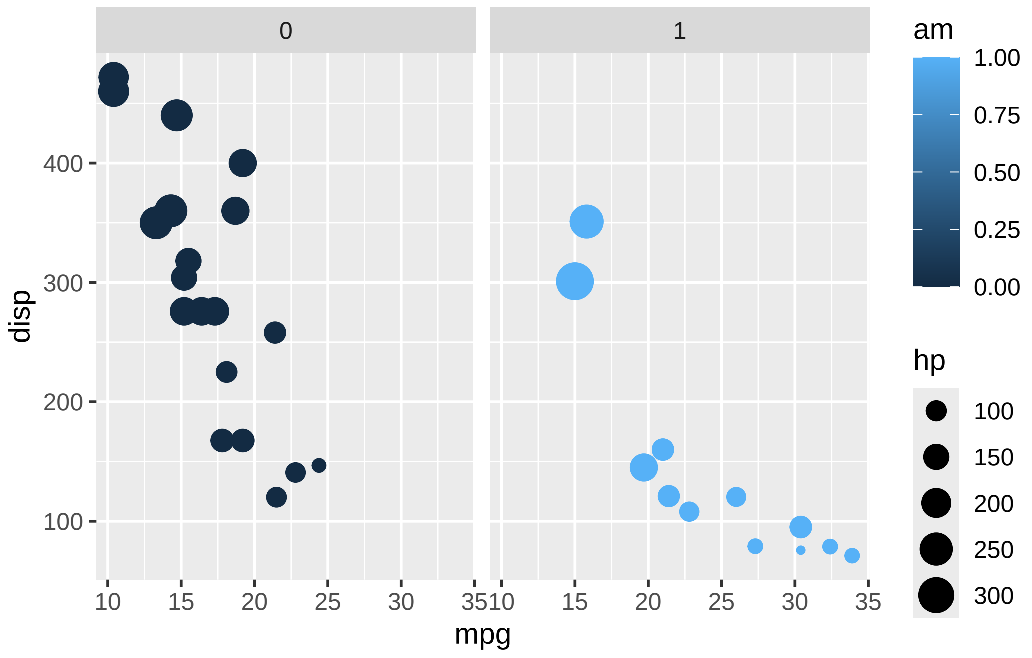


```
ggplot(mtcars) +
  aes(x=mpg, y=disp, size=hp) +
  geom_point(col="blue")
```



You can plot subgraph with the facet layer

```
ggplot(mtcars) +
  aes(x=mpg, y=disp, size=hp, col=am) +
  geom_point() +
  facet_wrap(~am)
```

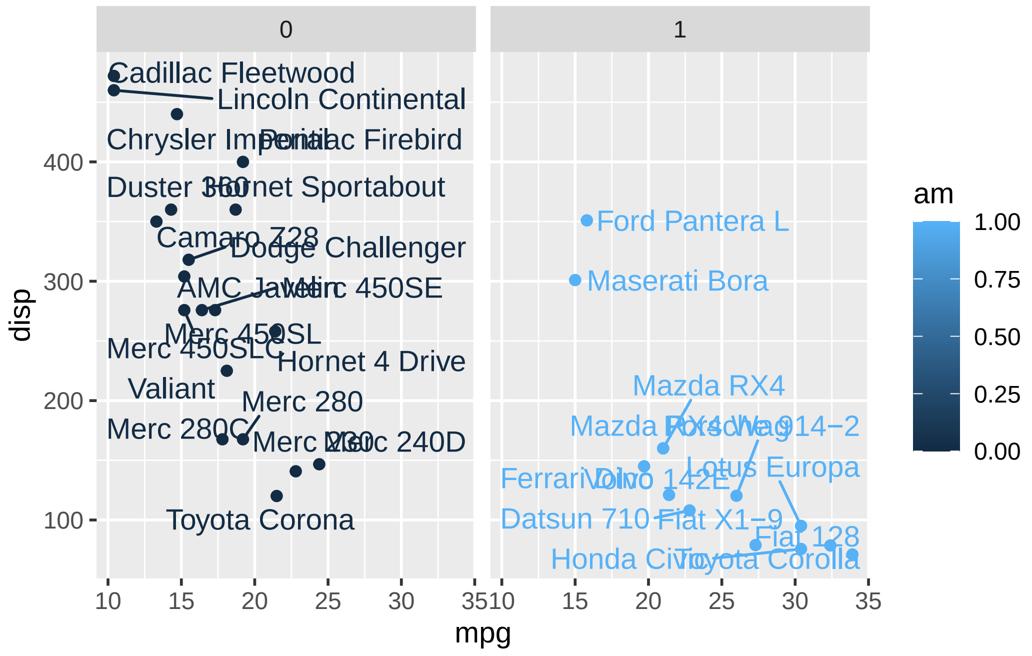


How can we identify what data is each point? But we need to install ggrepel

```
rownames(mtcars)
```

```
 [1] "Mazda RX4"           "Mazda RX4 Wag"       "Datsun 710"
 [4] "Hornet 4 Drive"      "Hornet Sportabout"   "Valiant"
 [7] "Duster 360"          "Merc 240D"           "Merc 230"
[10] "Merc 280"            "Merc 280C"           "Merc 450SE"
[13] "Merc 450SL"          "Merc 450SLC"         "Cadillac Fleetwood"
[16] "Lincoln Continental" "Chrysler Imperial"   "Fiat 128"
[19] "Honda Civic"         "Toyota Corolla"      "Toyota Corona"
[22] "Dodge Challenger"    "AMC Javelin"         "Camaro Z28"
[25] "Pontiac Firebird"    "Fiat X1-9"           "Porsche 914-2"
[28] "Lotus Europa"        "Ford Pantera L"      "Ferrari Dino"
[31] "Maserati Bora"       "Volvo 142E"
```

```
library(ggrepel)
ggplot(mtcars) +
  aes(x=mpg, y=disp, col=am, label=rownames(mtcars)) +
  geom_point() +
  facet_wrap(~am) +
  geom_text_repel()
```



Now section 7. Going further.

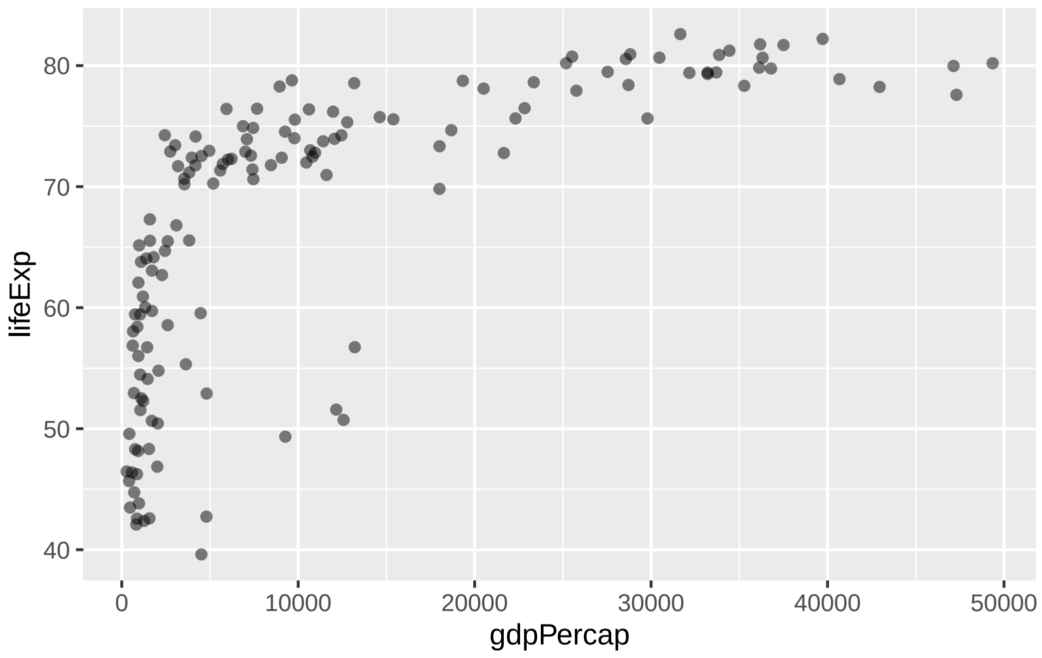
```
library(gapminder)
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.ts

gapminder <- read.delim(url)
```

```
library(dplyr)
```

```


Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag
```

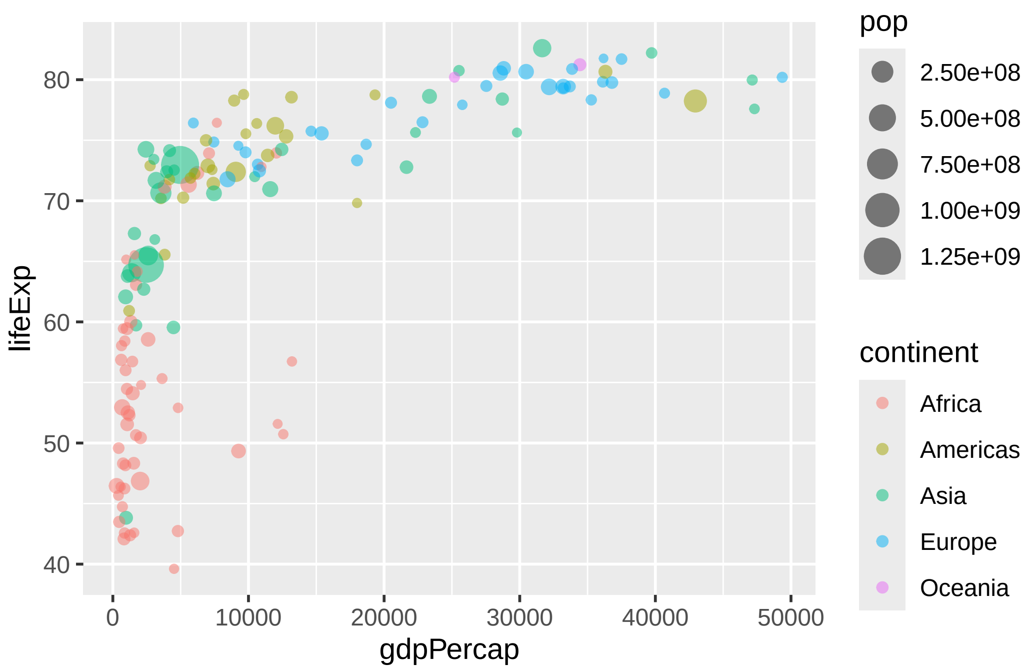
```
The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```r
gapminder_2007 <- gapminder %>% filter(year==2007)

ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point(alpha=0.5)
```



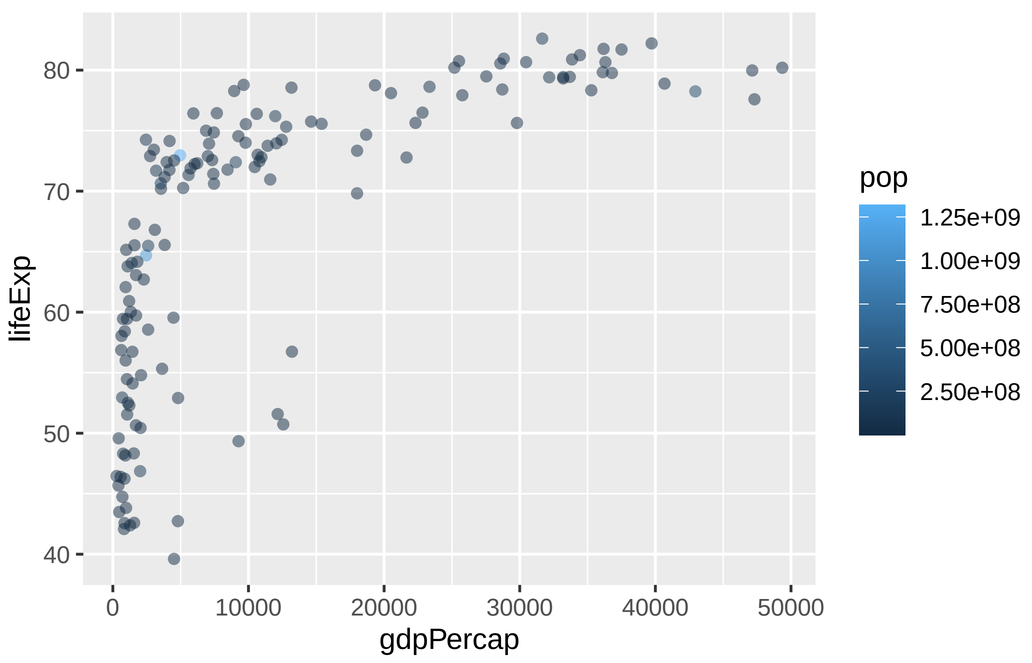
Now we are adding more variables to the aesthetic leyer:

```r
gapminder_2007 <- gapminder %>% filter(year==2007)

ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
  geom_point(alpha=0.5)
```



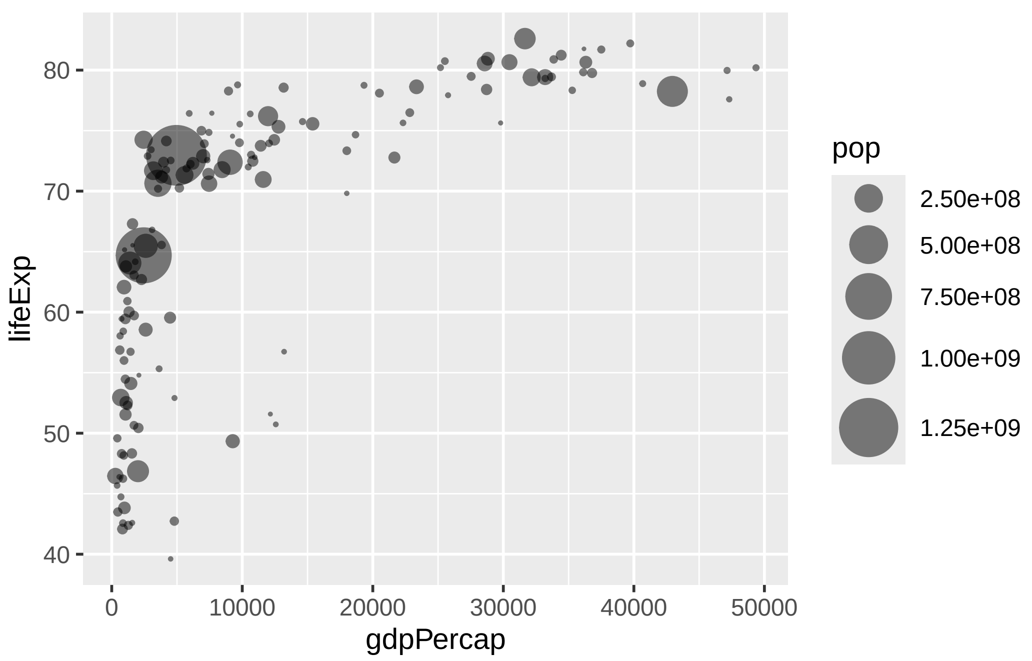
Coloring by population

```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp, color=pop) +
  geom_point(alpha=0.5)
```



Another way to write this code:

```
ggplot(gapminder_2007) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 size = pop), alpha=0.5) +
  scale_size_area(max_size = 10)
```



NOW LETS GO BACK TO THE 6TH PART…

```
url <- "https://bioboot.github.io/bimm143_S20/class-material/up_down_expression.txt"
genes <- read.delim(url)
head(genes)
```

```
        Gene Condition1 Condition2      State
1      A4GNT -3.6808610 -3.4401355 unchanging
2       AAAS  4.5479580  4.3864126 unchanging
3      AASDH  3.7190695  3.4787276 unchanging
4       AATF  5.0784720  5.0151916 unchanging
5       AATK  0.4711421  0.5598642 unchanging
6 AB015752.4 -3.6808610 -3.5921390 unchanging
```

There are `n nrows(genes)` genes in this data set.
Functions such as `nrows()`, `ncol()`, and `table()` are useful and important.

```
nrow(genes)
```

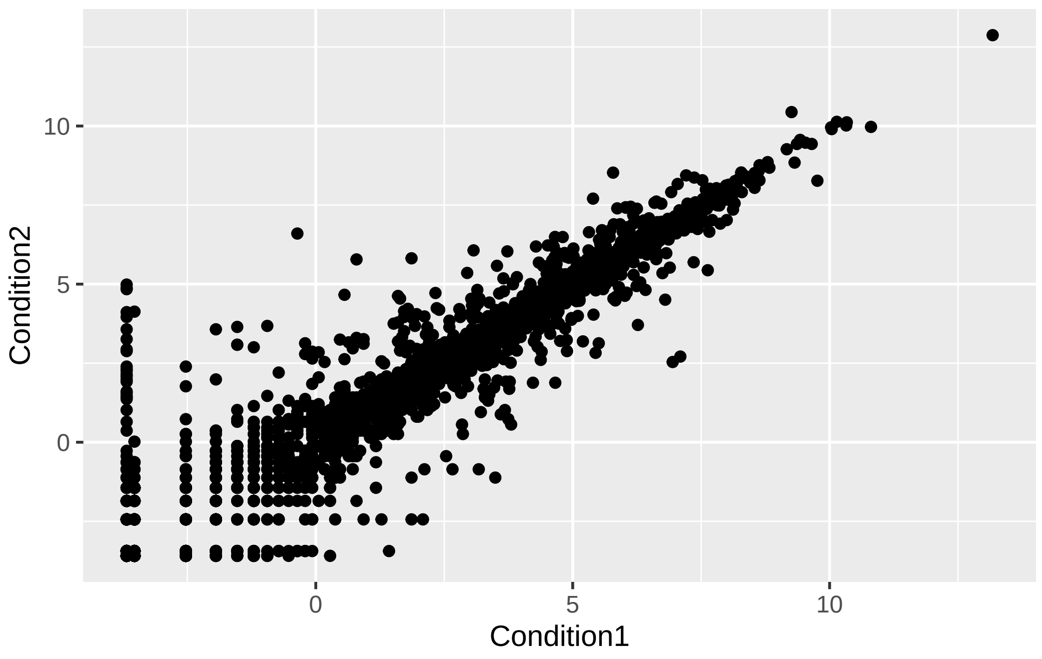
```
[1] 5196
```

```r
unique(genes$State)
```

```
[1] "unchanging" "up"         "down"
```

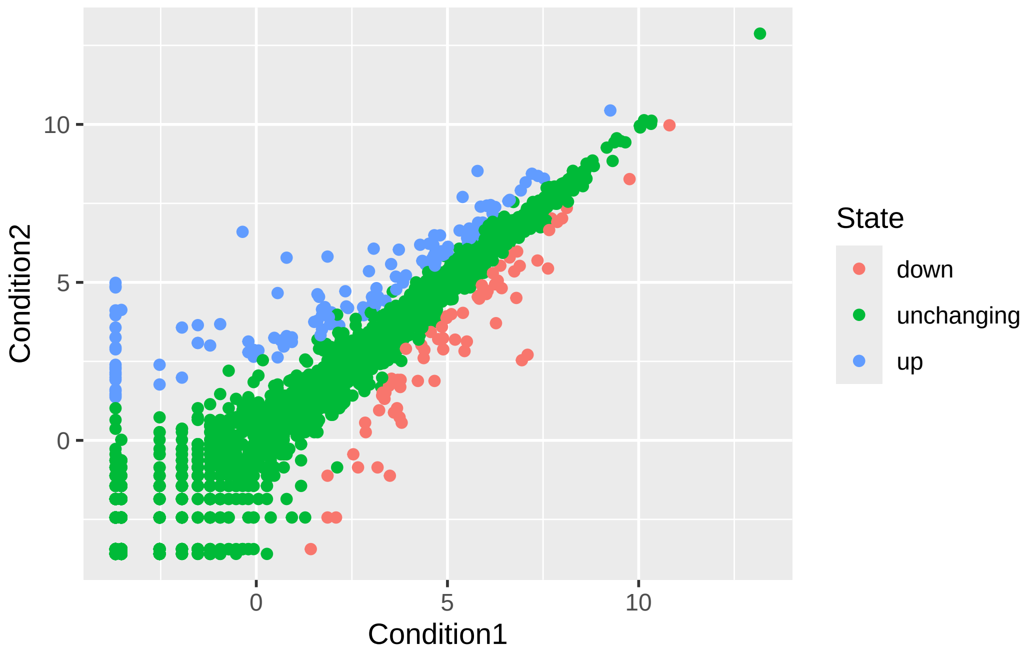
Now we need to compare the two conditions

```r
ggplot(genes) +
  aes(x = Condition1, y=Condition2) +
  geom_point()
```



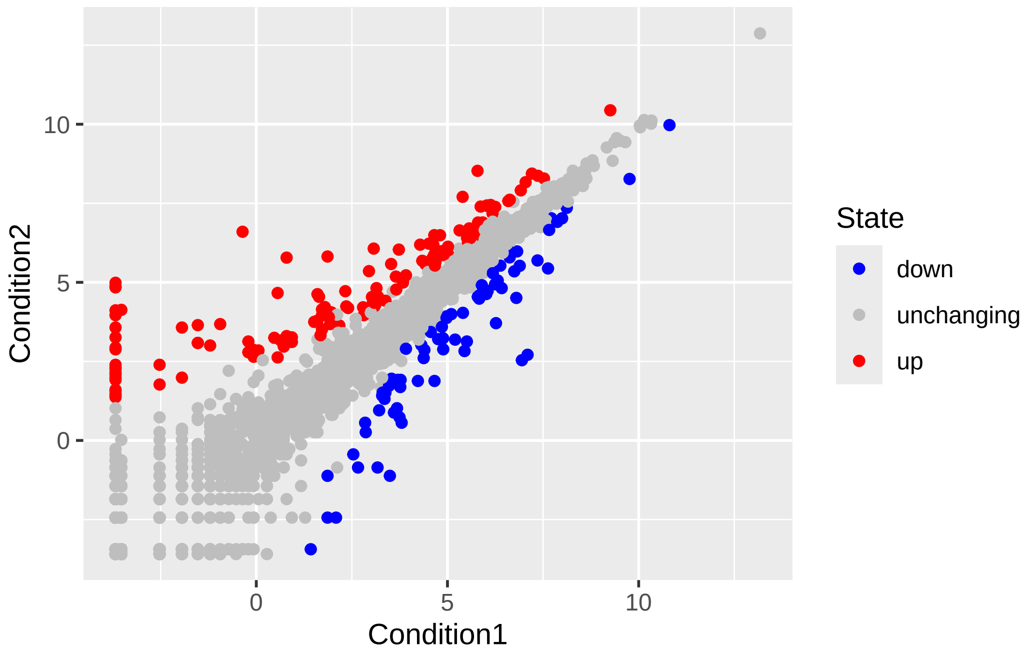
With colors and saving it as a vector

```r
p <- ggplot(genes) +
  aes(x = Condition1, y=Condition2, col = State) +
  geom_point()
p
```



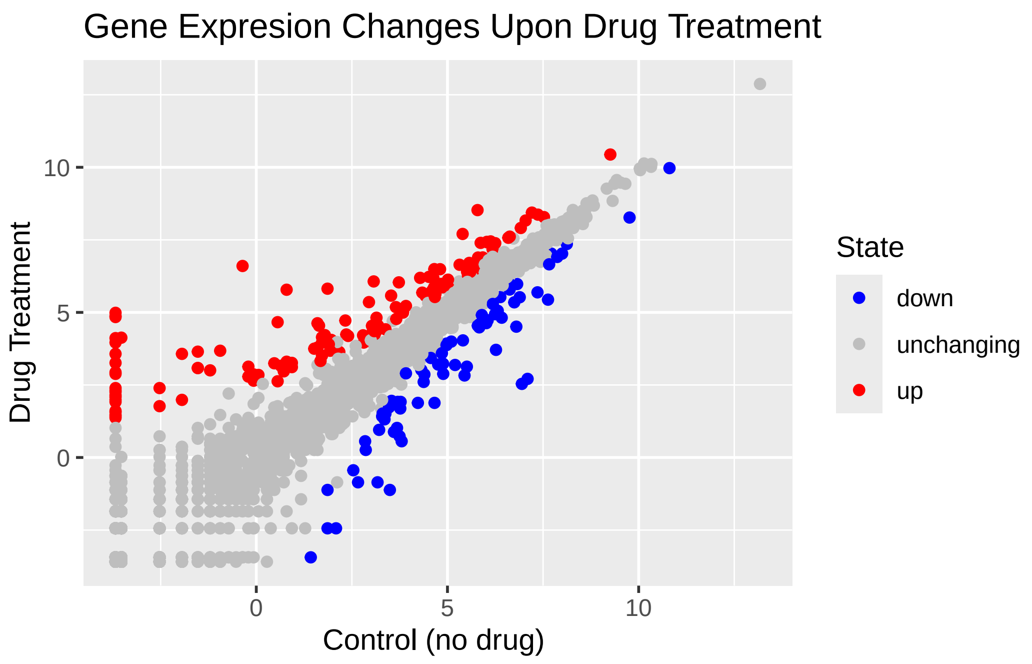
Then, we wanna change the colors to common used ones in gene expression profiling.

```
p + scale_colour_manual( values=c("blue","gray","red") )
```



If we want to add labels, we can use the function labs(). For this, let define x as control treatment and y as drug treatment.

```
p + scale_colour_manual( values=c("blue","gray","red") ) +
  labs(title="Gene Expresion Changes Upon Drug Treatment",
         x="Control (no drug) ",
         y="Drug Treatment")
```



Key points from the lesson: Saving plots with **ggsave()** Different plot "types" with different `geoms_**()` Faceting with `facet_wrap()` Multi-plot layout with the **patchwork** package.